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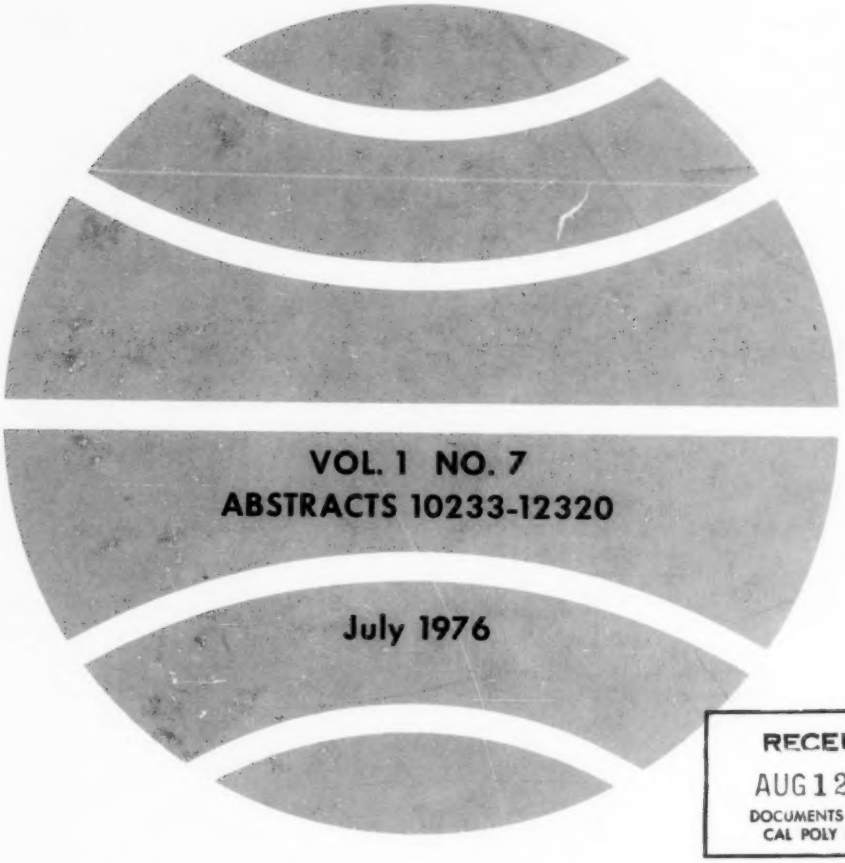

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Volume 1, Number 7, July 1976

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    routines for numerical integration
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SCHULER, V.J., Experimental studies in
    culling marine fishes of Southern
    California with screens and
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SCOTTI, L.J., See HAMBHAR, J.A.,
    75:705
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Subjects

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    size of coal particles), 75:702
COAL GASIFICATION
    See also COED PROCESS
             SYNTHANE PROCESS
COAL GASIFICATION/BI-GAS PROCESS
  Environmental aspects of the BI-GAS process
    (Reactive components in coal are completely
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is indexed as:

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    75:00744 (NSF-RA/N--74-144)
TEXTRON, INC., SYLMAR, CALIF. (USA). SPECTROLAB DIV.
  Terrestrial photovoltaic power systems with sunlight
    concentration. Quarterly porgress report, July 1,
    1974--September 30, 1974, 75:00737 (NSF-RA/N--74-129)
THERMO ELECTRON CORP., WALTHAM, MASS. (USA)
  Advanced thermionic technology, FY1975. Progress report
    number 4, October 1974, 75:00821 (TE--4190-57-75)
TYCO LABS., INC., WALTHAM, MASS. (USA)
  Continuous silicon solar cells. Third quarter progress
    report, July 1, 1974--September 30, 1974, 75:00742
    (NSF-RA/N--74-139)
  Scale-up of program on continuous silicon solar cells.
    Semiannual progress report, May 1, 1974--June 30, 1974,
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ERDA ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 10762, 10793, 10850, 10857

PROCESSING

REFER ALSO TO CITATION(S) 10840, 10848, 10849

CARBONIZATION

10233 (PB—239384) **Clean coke process--summary of bench-scale studies. Research and development interim report, Mar 72-Apr 1974.** (USS Engineers and Consultants, Inc., Pittsburgh, Pa. (USA)). Jan 1975. Contract DI-14-32-0001-1220. 155p. NTIS $3.90.

The clean coke process is designed to produce metallurgical coke, chemical feedstocks, and fuels from nonmetallurgical-grade coals. The principal reactions involve low-temperature carbonization and noncatalytic hydrogenation of coal and are practiced in a manner that minimizes contamination of the environment. Bench-scale studies were made, principally in the areas of coal preparation, carbonization-desulfurization, and hydrogenation. The results of the bench-scale work are summarized and material balances and yield data for all operations are included. (GRA)

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 10241

HYDROGENATION

REFER ALSO TO CITATION(S) 10233

10234 Improved heat pipe methanator. Ranken, W.A.; Kemme, J.E. (to U.S. Energy Research and Development Administration): US Patent Application 571,655. Filed date 25 Apr 1975. 8p.

When making a synthetic natural gas from coal, the raw product gas must be upgraded to a high BTU pipeline quality gas. This is done by using the shift reaction to increase the hydrogen-carbon dioxide ratio in the raw gas. This mixture is then passed through a catalyst bed where it reacts exothermally to give a nominal yield of $CH_4 + H_2O$. A major problem in the design of methanator units is removal of heat from the catalyst. If the catalyst temperature is not held within relatively narrow limits, the poisoning rate increases sharply and catalyst lifetime is reduced. An even more serious consequence of inadequate heat removal is the formation of hot spots, which can propagate and rapidly destroy the effectiveness of a catalyst. The present invention takes advantage of the self-contained heat transfer capability of the heat pipe to provide a methanator with a simple configuration combining the catalyst bed, incoming gas preheat section and thermal recovery in one unit. The catalyst is sprayed on the outer wall of each easily removable heat pipe, enabling easy replaceability of the catalyst.

GASIFICATION

10235 (PB—241141) **Evaluation of pollution control in fossil fuel conversion processes. Gasification; section I: CO_2 Acceptor Process. Final report.** Jahnig, C.E.; Magee, E.M. (Exxon Research and Engineering Co., Linden, N.J. (USA)). Dec 1974. Contract EPA-68-02-0629. 68p. NTIS $4.25.

Environmental Protection Technology Series rept. See also report dated Jul 1974, PB—237694.

The CO_2 Acceptor Coal Gasification Process is reviewed from the standpoint of its effect on the environment. The quantities of solid, liquid, and gaseous effluents were estimated, where possible, as well as the thermal efficiency of the process. For the purpose of reducing environmental impact, a number of possible process modifications or alternatives have been proposed and new technology needs have been pointed out. (GRA)

10236 Is coal next. McGrath, H.G. pp 88-91 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

If we do not discover substantial new deposits of oil and gas in the US, both onshore and offshore, it will be necessary to rely more and more on the vast coal reserves. Assuming further that new discoveries of oil and gas, both onshore and offshore, will, at best, be equivalent only to a small part of Saudi Arabia's or Iran's crude oil and gas reserves, the following timetable suggests itself: For the rest of this decade we may rely principally on oil, gas, and low-sulfur coal. However, well before 1980, the use of high-sulfur coal, with stack-gas clean up or flue gas desulfurization, will become common commercial practice. After 1980, we will see extensive conversion of coal to gas and oil. Both low-Btu gas (150-350 Btu/CF) and high-Btu gas (the equivalent of methane or natural gas) will be manufactured. Gasification and liquefaction are expected to become an important part of the coal industry. Coal to oil, via the hydrogenation and/or gasification routes, is a reality as far as the technology is concerned. However, many years will pass before we will see these processes having a substantial impact. (auth)

10237 Evaluation of coal conversion and utilization processes to provide clean fuel. Briggs, D.E. (Univ. of Michigan, Ann Arbor). pp 108-114 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

At the request of the Task Force on Coal Utilization of the Electric Power Research Institute, a team of 6 faculty members of the College of Engineering of the University of Michigan assessed the various processes to convert coal to clean fuels or utilize coal in environmentally acceptable ways for electric power generation. The team was asked to determine which processes had the greatest potential for commercial development to serve the power industry, and how research and development funds should be spent to expedite the development of viable commercial processes. The committee evaluated 38 different processes. The conclusion reached is that the industry is diverse with diverse conditions and needs. As a consequence depending on the coals available, location and needs, several of the processes now under development can be expected to have commercial potential. The methods of evaluation and some of the processes are described briefly. (LTN)

10238 Environmental impacts of coal gasification and liquefaction facilities. Lemmon, A.W. Jr. (Battelle-Columbus Labs., OH). pp 115-120 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

The processing of coal to provide gaseous and liquid products, byproducts and solid wastes can lead to the release of unwanted materials into the environment. Information is presented on the emissions from coal gasification and liquefaction processes, current and expected regulations which should eventually lead to limiting these emissions to acceptable levels, and the problem areas which exist in procedures and processes for controlling emissions and impacts. Difficult problem areas are further exphasized as being constraints to development and implementation of coal-processing techniques. (auth)

10239 Two-stage, self-agglomerating, fluidized-bed coal gasification process. Corder, W.C. (Battelle Columbus Labs., OH). pp 123-128 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

The two-stage, self-agglomerating fluidized-bed gasification process or AB Process is a pressurized, two-stage, fluidized-bed system involving combustion of coal or char in one fluidized bed and the steam gasification of coal in a separate fluidized bed. The block diagram shown is representative of the PDU under construction. The heat for the gasification reactions is provided by circulation of ash from the burner to the gasifier. A key feature of the process is the application of the "self-agglomerating" method of fluidized-bed combustion. The self-agglomerating method of fluidized-bed combustion consists of operation of the fluidized-bed burner under temperature and velocity conditions such that the fly ash in the coal is agglomerated or pelletized in a controlled way into free-flowing, inert solid pellets. These pellets or ash agglomerates serve as a moving burden, direct-contact, heat-transfer medium. The current OCR/A.G.A.-sponsored program was initiated in September 1972. The general objective of the current program is larger-scale development of the process at higher-than-atmospheric pressure, as a part of a practical and economical method for producing a synthesis gas by steam gasification of coal. The synthesis gas would be suitable for further conversion to pipeline gas. (auth)

LIQUEFACTION

REFER ALSO TO CITATION(S) 10236, 10237, 10238, 10243

10240 (PB—240371) **Evaluation of pollution control in fossil fuel conversion processes. Liquefaction: section I. COED process. Final report.** Kalfadelis, C.D.; Magee, E.M. (Exxon Research and Engineering Co., Linden, N.J. (USA)). Jan 1975. Contract EPA-68-02-0629. 72p. NTIS $4.25.

The FMC Corporation's COED coal conversion process is reviewed form the standpoint of its potential for affecting the environment. Estimates of the quantities of solid, liquid, and gaseous effluents are included where possible, as well as the thermal efficiency of the process. A number of possible process modifications or alternatives are proposed and new technology needs, aimed at lessening adverse environmental impact, are discussed. (GRA)

10241 Liquefaction and desulfurization of coal using synthesis gas. Fu, Y.C. (to U.S. Energy Research and Development Administration). US Patent Application 564,182. Filed date 1 Apr 1975. 14p.

A process has been invented for the desulfurization and liquefaction of coal which permits the use of inexpensive synthesis gas rather than requiring the use of the more expensive hydrogen and which produces a liquid oil product suitable for use as a fuel oil. By the process of this invention for desulfurizing and liquefying coal, a feed stock of the coal in a liquid slurry is contacted with a treat gas of hydrogen, carbon monoxide, and steam, in a reactor, in the presence of a desulfurization catalyst selected from the group consisting of cobalt molybdate supported on alumina, silica-stabilized cobalt molybdate supported on alumina and nickel molybdate supported on alumina and an alkali metal catalyst selected from the group consisting of sodium carbonate, sodium formate and potassium carbonate, at a temperature of 375 to 475°C and a pressure of 1500 to 5000 psig, whereby the coal is desulfurized and liquefied to a fuel oil product.

SOLVENT EXTRACTION

10242 (LBL—4434) **Action of solvents on subbituminous coal below pyrolysis temperature.** Draemel, D.C.; Grens, E. II. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1975. Contract W-7405-Eng-48. 88p. Dep. NTIS $5.00.

Thesis. Submitted by D.C. Draemel.

The interaction of a Western subbituminous coal with solvents of four representative types, vis., hexane, benzene, tetralin, and phenol, has been studied at the equilibrium pressure of each solvent in the temperature range of from 150 to 350°C. Extractions by reflux liquid were conducted at times varying from 4 to 200 hr. The amount extracted in 4 hr ranged from less than 2 wt.-percent with hexane at 150°C up to 57.4 wt.-percent with phenol at 300°C. Number average molecular weights for the benzene-soluble fractions of the extracts were determined by vapor pressure osmometry using benzene as the medium. The benzene solubles, or asphaltenes, from benzene and tetralin extractions at 200°C for 4 hr had an average molecular weight of near 800, while the phenol extract asphaltenes from a 200°C, 4 hr extraction had an average molecular weight of roughly 600. The extracts were found to be hydrogen-rich compared to the raw coal; the extent of enrichment varied inversely with yield, i.e., with amount extracted. Consistent with these higher hydrogen contents, the shallow extracts using tetralin as a solvent showed very low aromaticity in proton NMR analysis. No hydrogen transfer from tetralin to the coal was evidenced (by naphthalene in the solvent) for contacting temperatures up to 300°C, but transfer of 0.5 to 0.7 percent hydrogen per unit weight of dry ash-free coal occurred at 350°C. The low aromaticityof extracts, along with the generally higher yields and strong increases in yield with increasing temperatures, suggest possible differences in the coal/solvent interaction behavior with subbituminous coal compared to higher rank coals. (auth)

BY-PRODUCTS

REFER ALSO TO CITATION(S) 10855

10243 (AD-A—007923) **Preparation of gas turbine engine fuel from synthetic crude oil derived from coal. Final report on Phase 2.** Eisen, F.S. (Sun Oil Co., Marcus Hook, Pa. (USA)). 6 Feb 1975. Contract N00014-74-C-0568. 73p. NTIS $4.25.

Includes Appendix A, Phase 1.

A 232 gallon gas turbine fuel sample containing 23 vol.percent aromatics (20-25 vol.percent specification target) was prepared from synthetic crude oil (syncrude) derived from Western Kentucky coal. The seven fuel specifications designated as most important were all met with the exception of smoke point. The following major processing steps were used to prepare the sample: initial distillations (atmospheric distillation of the syncrude to remove light hydrocarbons and water, and vacuum distillation to remove the material boiling above about 500F); hydrogenation of the resulting kerosene fraction to produce a 20-25 vol.percent aromatics product; final atmospheric distillation to remove light ends and produce a 140 to 155F flash point product. (GRA)

PROPERTIES

REFER ALSO TO CITATION(S) 11127

10244 (BERC—0020-2) **Mass spectrometric analytical services and research activities to support coal-liquid characterization research. Quarterly report, September 9, 1975—December 8, 1975** . Scheppele, S.E. (Oklahoma State Univ., Stillwater (USA). Dept. of Chemistry). 29 Dec 1975. Contract E(34-1)-0020. 29p. Dep. NTIS $4.00.

Interfacing of the Perkin Elmer model 3920 gas chromatograph with the CEC 21-110B mass spectrometer has been completed and the GC/MS system is presently being made operational. Detailed descriptions of the heated-probe assembly and the rapid mass-scanning module are given. The field ionization (FI) source for the CEC 21-110B mass spectrometer is routinely operational. Reproducibility of ion abundances using this source has been investigated using a Synthoil sample and a sample of hydrogenated anthracene oil. For both samples the average percent deviations in the ion abundances are 8.90 and 9.48 percent, respectively. Application of the technique of FI mass spectrometry to semi-quantitative analysis of coal type mixtures has been explored using known samples. The consequences of sensitivity data on the analytical results have been considered. For known samples relative weight and relative mole sensitivities have been determined with respect to naphthalene. Although inclusion of sensitivity data increases the accuracy of the analysis, reasonable estimates of sample composition can be obtained without their use. (auth)

10245 Evaluation of low-sulfur western coal characteristics and utilization. Ctvrtnicek, T.E.; Rusek, S.J.; Sandy, C.W. (Monsanto Research Corp., Dayton, OH). pp 102-106 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

Several topics are discussed which aid in further defining the characteristics and utilization of the low-sulfur western coal deposits: The location and occurrence of the western coal deposits, their properties, their effect on existing combustion equipment, and some aspects of coal transportation to the consumer markets. Over 66 percent of the total estimated coal reserves contain 0.7 wt.-percent or less sulfur. For comparison, only 20 percent of the reserves in non-western locations fall in this category. Demonstrated, measured, and indicated reserves in all sulfur content categories amounting to 200 billion tons are known to exist. Production amounted to 50.6 million tons in 1972, of which 30 percent was shipped to non-western locations. Higher fouling rates and lower precipitator efficiencies may result from burning the low-sulfur western coals. The high volatile matter and low calorific value of western coals are discussed in terms of coal feed rates, boiler aeration, and pulveriser capacity. Advantages of using western coal from the standpoint of meeting EPA sulfur restrictions are discussed in terms of the coal's inherent low-sulfur content and increased sulfur retention in ash.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 10450, 10840, 11126

10246 Pilot plant study of various filter media in the control of fly ash emissions. McKenna, J.D.; Lipscomb, W.O.; Mycock, J.C. pp 168-173 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

Fabric filter dust collectors are suitable for control of fly ash from stoker fed coal fired industrial boilers in terms of both efficiency of dust removal and operating pressure drop. If two year bag life can be achieved with Teflon felt bags, fabric filters appear economically more attractive for industrial coal fired boilers than electrostatic precipitators. Filter media selection influences both efficiency of removal and operating pressure drop. Test results indicate that a laminate on a woven backing can achieve performance and operating characteristics similar to those of a felt media. The air-to-cloth ratio or superficial velocity is an important parameter influencing the outlet loading, for the type media tested. As the velocity is increased the overall outlet loading is increased. Different particle size fractions are affected differently by changes in velocity. The cleaning process can influence both pressure drop and efficiency. The question of bag life is the primary unanswered techno-economic question. It is anticipated that this question will be answered via a full scale demonstration program. (auth)

10247 Scrubbing with an impinger reactor. Hesketh, H.E. (Univ. of Illinois, Carbondale). pp 174-176 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

Significant improvements are being made in wet scrubbing devices. The impinger reactors appear to be able to make a significant contribution toward improved scrubbing while reducing energy requirements. Energy required in these systems is lower because less scrubbing liquid is required and pressure drops are minimized. The greatest operating cost of wet scrubbing systems is the gas pumping cost. The energy required to pump gas is directly proportional to the system pressure drop. By reducing pressure drop, as is achieved in the Pentapure and Polypure Impingers, the operating expenses should be significantly reduced. Further tests will be made to show the effectiveness of these improved scrubbing devices for control of fine particulates. (auth)

10248 Study of coal dust dispersion in wind tunnel. Boscak, V. (Geo. A. Hormel and Co., Coon Rapids, MN). pp 177-180 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

Coal dust dispersion from power plant outdoor storage piles by wind action presents a serious air pollution problem. The analysis of the problem began with meteorological and topographical considerations at the power plant station. A wind tunnel study of factors influencing the dispersion of coal dust was undertaken. The particle size distributions of western and coking coals were evaluated. An expression was developed that gives coal dust dispersion as a function of wind velocity and coal particle size. It is valid for erosion as a mode of coal dispersion and gives the percent of coal dispersed as an exponential function of the Froude number and some other parameters. Cohesion between coal particles seems to play an important role when the maximum coal particle size is under 590 microns. A dust suppression chemical for control of coal dust dispersion through wind action from outdoor coal piles was developed in the course of the study. (auth)

10249 Cost comparisons of flue gas desulfurization systems. McGlamery, G.G.; Tostrick, R.L. (Tennessee Valley Authority, Muscle Shoals, AL). pp 195-201 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

The results of an EPA-sponsored cost appraisal of the five most advanced flue gas desulfurization processes are described. Using data available in late 1973 from demonstration-scale systems in progress and a representative set of design and economic premises, detailed, highly visible capital investments and operating costs were estimated for the limestone slurry scrubbing, lime slurry scrubbing, magnesia slurry scrubbing, regeneration to acid, sodium solution scrubbing, regeneration to sulfur, and catalytic oxidation processes. Itemized capital costs are presented for a base case system (new 500-MW unit burning coal with 3.5 percent sulfur, 30-year life - 127,500 hours operation, 90 percent SO_2 removal, fly ash removal included) for each process assuming proven technology, a 3-year construction schedule (1972-1975, midpoint of activity - 1974), no overtime, and an experienced design and construction team. Energy costs reflecting recent worldwide escalation are applied to the operating costs. In addition to the detailed base cases, numerous supplementary estimates are given to cover such varibles as unit size, fuel type, sulfur content of fuel, plant status (new vs. existing), onsite versus offsite solids disposal and SO_2 removal. The five processes are ranked according to the results; the accuracy of the estimates is also discussed. Using results from recent in-house evaluation studies, additional less-detailed comparisons are presented for limestone scrubbing with benzoic acid, two lime scrubbing options, sodium scrubbing with H_2SO_4 production, and two double-alkali processes. (auth)

10250 Status of the FW-BF flue gas desulfurization project: Gulf Power Company Scholz Station. Bichoff, W.F.; Strum, J.J. pp 202-207 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

The design of a FW-BF Dry Adsorption System for Gulf Power Company's Scholz Station Unit No. 2 (47.5 MW; plant located in Chattahoochee, Florida) is discussed. Basic design premises on which the design is based are presented. Process description, technical details and operating advantages of the FW-BF System are described. The construction status discussion is supplemented with a slide presentation showing the FW-BF System in various stages of construction. (auth)

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 10235, 10238, 10240, 10839, 10859, 11127, 11438, 11453, 11458, 11471

10251 (ORO—4946-1) Environmental aspects of coal production in the Appalachian Region. Progress report, June 1, 1975—May 31, 1976. Minear, R.A.; Tschantz, B.A.; Rule, J.H.; Vaughan, G.L.; Overton, D.E.; Briggs, G. (Tennessee Univ., Knoxville (USA). Appalachian Resources Project). 1976. Contract E(40-1)-4946. 96p. Dep. NTIS $5.00.

Work on the hydrology of surface mine spoil banks is reported, including the mobilization of heavy metals in water (from wells in the spoil banks, ponds, seepage flow, streams, etc.) and in stream sediments. Results are described briefly and metal concentrations are given in tables. Lead, zinc, and possibly chromium were higher in sediments in streams involving strip-mined areas. The biological effects seem to be more significant: Both the total number of organisms and the diversity index were lower in areas associated with mining activity. Samples have been taken for the analysis of heavy metals and enzyme activities. (LTN)

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 10284, 10854

10252 (NP—20804) **Coal in Tennessee.** (Tennessee Energy Office, Nashville (USA)). Jun 1975. 127p. Tennessee Energy Office, 250 Capitol Hill Bldg., Nashville, TN 37219.

Information on coal in Tennessee is provided as follows: reserves, production, consumption, transport, regulations, legislation, severance tax, and research programs (including the development of magnetohydrodynamic equipment to burn coal and produce electricity directly). (LTN)

MINING

REFER ALSO TO CITATION(S) 10257, 10258, 10259, 10260, 10261, 10262, 10263, 10264, 10266, 10267, 10268, 10858

10253 (COM—74-11717) **Electromagnetic noise in McElroy mine. Summary report, January 1973—June 1974.** Kanda, M.; Adams, J.W.; Bensema, W.D. (National Bureau of Standards, Boulder, Colo. (USA)). Jun 1974. Contract H0133005. 172p. (NBSIR—74-389). NTIS $6.25.

Two different techniques were used to make measurements of the absolute value of electromagnetic noise in and above an operating coal mine, McElroy Mine, located near Moundsville, West Virginia. The 300-volt-dc and 480-volt-ac machinery was measured to see the electromagnetic environment it created. One technique measures noise over the entire electromagnetic spectrum of interest for brief time periods. It is recorded using broadband analog magnetic tape and the noise data is later transformed to give spectral plots. The other technique records noise amplitudes at several discrete frequencies for a sufficient amount of time to provide amplitude probability distributions. The specific, measured results are given in a number of spectral plots and amplitude probability distribution plots. (GRA)

10254 (MESA-IR—1006) **Progress of mine systems in Australia.** Schlick, D.P. (Mining Enforcement and Safety Administration, Washington, D.C. (USA)). 1975. 19p. Dept. of the Interior, Arlington, VA.

An investigation of mining in Australia is reviewed with special emphasis on shortwall mining and pillar recovery in underground coal mines, reclamation of mined areas at strip coal and noncoal mines, and mine rescue operations. The investigation was made to determine (1) the application of Australian mining, reclamation, and rescue systems to US mines, (2) the impact of such systems on MESA's operations if adopted in the United States, and (3) to obtain information that may be used in developing tentative plans in MESA to deal with such systems in anticipation of adoption. A description of Australian geology and mining operations is included and practical recommendations for considerations and action, principally by MESA, are considered. (auth)

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 10245, 10248

10255 (AD-A—008258) **Multibucket excavator PMT-3.** Asin, G.N.; Ushanov, A.V. Translated from *Stroit. Dorozhn. Mash.*; No. 12, 18-19(1971). 6p. (FSTC-HT—23-751-73). NTIS $3.25.

A multibucket excavtor PMT-3 is used for transfer of milled peat of fine coal from unloading trench to conveyor belt for the fuel supply of thermal electric plants. It combines the movement of the machine along tracks, which are on various levels, with the perpendicular movement of the bucket chain for the transfer of fuel. PMT-3 has successfully passed governmental acceptance tests and meets specifications of explosion-proof and dustproof electrical apparatus installations. PMT-3 is constructed in keeping with technical specifications of the Moscow division of the Institute of "Thermal Electrical Projects," along with test operations of commercial excavators, PMT-2. (GRA)

COMBUSTION

REFER ALSO TO CITATION(S) 10237, 10245, 10847

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 10848, 10849, 10851, 10852, 10853, 10856

10256 (NP—20788) **Coal: Pennsylvania anthracite in 1974.** (Bureau of Mines, Washington, D.C. (USA)). 3 Oct 1975. 36p. Bureau of Mines, Washington, DC.

The production and value of anthracite in Pennsylvania is discussed with numerous tables of data. Domestic production, as well as world production, is also treated in a later section of the report. Information is included on legislation and government programs, distribution, consumption and uses, stocks, prices and specifications, and technology. (EJH)

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 10253, 10254, 11238

10257 (AD-A—009852) **Final report on development of a system to suppress and extinguish fully developed coal dust explosions. Technical report.** Lull, D.B.; Johnson, L.D.; Morris, T.F.; Canfield, J.A. (Naval Surface Weapons Center, Dahlgren, Va. (USA)). Feb 1975. 226p. (NSWC/DL-TR—3151). NTIS $7.50.

A working prototype triggered barrier system has been designed, built and tested. It has successfully suppressed and extinguished several propagating coal dust explosions in two shock tube facilities which are of significant scale relative to mine extries. Design and performance data on the suppression system and components are included. Flame front and pressure wave trajectories are plotted for several tests in which dust explosions were extinguished showing the operating time and the effects of the suppression system. (GRA)

10258 (PB—240426) **Design criteria for panic bars and auger miner safety. Panic bar study. Volume 1. Continuous miners. Open file report (final), 1973-74.** Marrus, L.D.; Rogne, C. (Bendix Aerospace Systems Div., Ann Arbor, Mich. (USA)). 23 Jan 1974. Contract H0133031. 130p. (BSR—4113(Vol.1)). NTIS $5.75.

The panic bars (and associated linkages and electrical circuitry) that are defined in this document are a machine operator-actuated control for the emergency deenergization of the tram motors on self-propelled, electric and diesel face equipment, including haulage equipment such as shuttle cars. There are nine basic types of panic bars (and several variations) that are recommended in this document, but all of the panic bars are characteristically of the "fire door" type that is frequently encountered on outside exit doors of many public and some commercial buildings. It is also the intent of the following panic bar designs that, when emergency brakes are added to the face equipment machinery for which they are required, that they be designed and hooked up so that actuation of the panic bar will result in automatic application of the emergency brakes (immediately following the deenergization of the tram motors). (GRA)

10259 (PB—240427) **Design criteria for panic bars and auger miner safety. Panic bar study. Volume 2. Cutters/face drills. Open file report (final), 1973-74.** Marrus, L.D.; Rogne, C. (Bendix Aerospace Systems Div., Ann Arbor, Mich. (USA)). 23 Jan 1974. Contract H0133031. 151p. (BSR—4113(Vol.2)). NTIS $6.25.

10260 (PB—240428) **Design criteria for panic bars and auger miner safety panic bar study. Volume 3. Loaders. Open file report (final), 1973-74.** Marrus, L.D.; Rogne, C. (Bendix Aerospace Systems Div., Ann Arbor, Mich. (USA)). 23 Jan 1974. Contract H0133031. 83p. (BSR—4113(Vol.3)). NTIS $4.75.

10261 (PB—240429) **Design criteria for panic bars and auger miner safety. Panic bar study. Volume 4. Roof bolters. Open file report (final), 1973-74.** Marrus, L.D.; Rogne, C. (Bendix Aerospace Systems Div., Ann Arbor, Mich. (USA)). 23 Jan 1974. Contract H0133031. 187p. (BSR—4113(Vol.4)). NTIS $7.00.

10262 (PB—240430) **Design criteria for panic bars and auger miner safety. Panic bar study. Volume 5. Shuttle cars. Open file report (final), 1973-74.** Marrus, L.D.; Rogne, C. (Bendix Aerospace Systems Div., Ann Arbor, Mich. (USA)). 23 Jan 1974. Contract H0133031. 136p. (BSR—4113(Vol.5)). NTIS $5.75.

10263 (PB—240431) **Design criteria for panic bars and auger miner safety. Panic bar study. Volume 6. Tractors and scoops. Open file report (final), 1973-74.** Marrus, L.D.; Rogne, C. (Bendix Aerospace Systems Div., Ann Arbor, Mich. (USA)). 23 Jan 1974. Contract H0133031. 102p. (BSR—4113(Vol.6)). NTIS $5.25.

10264 (PB—240432) **Design criteria for panic bars and auger miner safety. Auger miner safety study. Volume 7. Final report. Open file report (final), 1973-74.** Marrus, L.D.; Rogne, C. (Bendix Aerospace Systems Div., Ann Arbor, Mich. (USA)). 23 Jan 1974. Contract H0133031. 85p. (BSR—4113(Vol.7)). NTIS $4.75.

The study developed designs to facilitate and accelerate rotation stoppage (and auger rotation start up so as to promote auger disengagement during miner responsibility) and to provide a time delay and warning signal prior to auger start up to permit any miners near the augers to get away from the augers before they start rotating. In the underground coal mines in the United States, there are four auger miners that are currently in use. They are in Jeffrey 100L and 100M, and the Wilcox WCM and the MK20A. (GRA)

10265 (PB—240471) **Short duration self-rescue breathing apparatus. Open file report.** Buban, E.E.; Gray, R.E. (Mine Safety Appliances Co., Pittsburgh, Pa. (USA). Research and Engineering Div.). 1 Apr 1974. Contract H0220071. 122p. NTIS $5.25.

A self-contained breathing apparatus was developed to provide complete respiratory protection for a miner in an irrespirable atmosphere. The apparatus has the desired features of comfort, reliability, maintainability, and quick-donning capability. The apparatus is packaged in a moistureproof envelope and is prptected in a shock-absorbing, fiberglass resin-carrying case. The apparatus is a small, light-weight, one-time-use device that can be readily worn on a miner's belt, requires no maintenance and is designed to have a shelf life of five years and a carrying life of three years. It is deployed to the use position in a period of 15 to 30 seconds. Man tests conducted in-house and at the National Institute of Occupational Safety and Health (NIOSH) testing laboratories established that this unit meets all performance requirements listed in the Code of Federal Regulations, Title 30, Part II, Subchapter B. Subpart H (CFR 30, Part II) for respiratory protective devices. (GRA)

10266 (PB—240637) **Foam suppression of respirable coal dust. Final report.** Wojtowicz, A.; Mueller, J.C.; Schwendeman, J.L.; Sun, S. (Monsanto Research Corp., Dayton, Ohio (USA)). Oct 1974. Contract H0111351. 114p. (MRC-DA—435). NTIS $5.25.

See also report dated Dec 1970, PB—204522.

This research program was conducted to determine if respirable coal dust emanating from a continuous-mining machine can be suppressed more effectively by a high-expansion foam than by the water sprays conventionally used. A high-expansion foam system was developed and tested on a continuous-mining machine under actual operation conditions. The utility of the system was demonstrated. (GRA)

10267 (PB—240667) **Use of vacutainers for collection of mine atmosphere samples. Report of investigations, 1974-75.** Freedman, R.W.; Humphrey, W.C.; Craft, R.L. (Bureau of Mines, Pittsburgh, Pa. (USA). Pittsburgh Mining and Safety Research Center). Jan 1975. 12p. (BM-RI—7999). NTIS $3.25.

As part of a continuing effort to reduce the weight and bulk of equipment that mining personnel must carry underground, an accurate and convenient gas sampler has been investigated for sampling mine atmospheres by mine inspectors after complete evaluation of 10 ml vacutainers. The latter are septum-stoppered glass tubes used in large numbers for routine blood sampling. These light-weight compact samplers yield results comparable to those obtained with conventional bottle samplers of 250 ml nominal capacity. (GRA)

10268 (PB—240838) **Methane ignition by frictional impact between aluminum alloys and rusted steel. Report of investigations.** Desy, D.H.; Neumeier, L.A.; Risbeck, J.S. (Bureau of Mines, Rolla, Mo. (USA). Rolla Metallurgy Research Center). Jan 1975. 36p. (BM-RI—8005). NTIS $3.75.

Research was conducted on ignition of methane by frictional sparks from aluminum alloys impacting rusty steel at typical coal mine fan speeds. Objectives were to establish incendivity of different commercial and experimental aluminum alloys and to evaluate several substitute materials for the aluminum-steel combination. All aluminum alloys produced some ignitions in a specially designed impact apparatus. Harder experimental alloys and those containing silicon tended to be more incendive than others. With normal experimental conditions, steels, brass, and plastic did not ignite methane-air when impacted on rusty steel. Constructional steel at high speed in oxygen-enriched atmosphere caused some ignitions. It is suggested that materials other than the aluminum-steel combination would minimize the hazard. (GRA)

REGULATIONS

REFER ALSO TO CITATION(S) 10252

PETROLEUM

REFER ALSO TO CITATION(S) 10762, 10793

RESERVES

REFER ALSO TO CITATION(S) 10861

BY-PRODUCTS

REFER ALSO TO CITATION(S) 10847, 10864, 10873

10269 (NP—20728) **Report to congress on petrochemicals.** (Federal Energy Administration, Washington, D.C. (USA)). 1975. 217p. Federal Energy Adm., Washington, DC.

The following aspects of the petrochemical industry are covered: petrochemical industry overview; petrochemical feedstocks; government controls - prices and allocation; and analysis of basic petrochemicals and petrochemical industry segments. (LK)

10270 (PB—240558) **Production of low-sulfur gasoline. Final report, Nov 1972-Jun 1974.** Hoot, W.F. (Kellogg (M.W.) Co., Houston, Tex. (USA)). Jul 1974. Contract EPA-68-02-1303. 149p. NTIS $5.75.

The use of catalytic converters is intended to control carbon monoxide and hydrocarbon emissions. However, the catalysts convert some of the sulfur in gasoline into sulfuric acid mist in the exhaust. The purpose of this study was to determine the impact on oil refineries to produce unleaded, low-sulfur gasolines and also to desulfurize all gasolines produced for United States sales. (GRA)

10271 (AD/A—005963) **Effect of temperature regime on the removal of sulfur compounds.** Geraskina, L.G.; Chernysheva, K.B.; Nikitin, E.E. Translated from *Tr. Leningr. Inzh.-Ekon. Inst.*; No. 89, 10-13(1972). 8p. (FSTC-HT—23-807-74). NTIS $3.25.

The effect of the temperature regime in the adsorptive scrubbing of thermal-cracking gasoline is analyzed. Scrubbed stock quality is investigated and changes in the sulfur load of adsorbents in the specified regime are discussed. (GRA)

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 10803, 10860, 10862, 10873

WASTE MANAGEMENT

10272 **New process for SO/sub x/ abatement from catcracker regenerator units.** Ctvrtnicek, T.E.; Hughes, T.W. (Monsanto Research Corp., Dayton, OH). pp 210-211 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

Approximately 33 percent of the gasoline required in the US is produced in fluidized bed (FCC) catalytic cracking units. These units are a source of atmospheric pollution. The pollutants include SO/sub x/, NO/sub x/, CO, and particulate matter. Emissions from these units are summarized. Results of an EPA funded program, which investigated conceptual techniques for reducing sulfur oxide emissions from refinery catalytic cracking units, are presented. The areas discussed include the following: catalytic cracking process description; identification of SO/sub x/ control alternatives; discussion of a new SO/sub x/ control technique; and economics of control alternatives. (auth)

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 10272, 10839, 10866, 10867, 11438, 11458, 11477

10273 (AD/A—004912) **Evaluation of an infrared oil film monitor. Final report, April 1973—August 1974.** Wright, D.E.; Wright, J.A. (Wright and Wright, Inc., Newton Center, Mass. (USA)). Sep 1974. Contract DOT-CG-33672-A. 102p. NTIS $5.25.

See also report dated Nov 1973, AD—778814.

An evaluation program was undertaken on a remote oil film detection instrument which uses the infrared reflectance of water surfaces. Oil slick detection is based on a change in the normal water reflectance ratio of two wavelengths in the 3 micron spectral region. Laboratory and field tests demonstrated the instrument's ability to reliably detect petroleum films while effectively ignoring non-hydrocarbon pollutants on the water surface. The report details test procedures and results as well as theory of operation and functional descriptions of the instrument. (GRA)

10274 (AD/A—005083) **In-situ detection of oil slicks utilizing differential evaporation: Phase II. System design. Final report.** Horvath, R.; Lirette, E.F.; Zuk, D.M. (Environmental Research Inst. of Michigan, Ann Arbor (USA). Infrared and Optics Div.). Mar 1974. Contract DOT-CG-33996-A. 37p. (ERIM—103900-9F). NTIS $3.75.

See also Phase 1, AD—779615.

This technical report describes the detailed design phase of a sensor system development program. The development is based upon a unique oil detection technique which utilizes fundamental differences in thermodynamic evaporation properties between liquids. The basic detection concept is defined, and the design parameters of the several subsystems required for implementation as a self-contained sensor system is described. Design features required to insure operability and survivability in a harbor or river marine environment are emphasized. Servicing requirements for replacement of expendable stores are also discussed. (GRA)

10275 (PB—240719) **Oil spill and oil pollution reports, July 1974-October 1974. Environmental protection technology series.** DeWitt, F.A. Jr.; Melvin, P. (California Univ., Santa Barbara (USA). Marine Science Inst.). Mar 1975. Contract EPA-R-803063. 218p. NTIS $7.25.

Oil spill events and oil pollution report summaries are compiled. Presented in the report are: (a) summaries of oil spill events; (b) summaries and bibliographic literature citations; (c) summaries of current research projects; and (d) patent summaries. (GRA)

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 10860, 10865, 10866

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 10863

NATURAL GAS

REFER ALSO TO CITATION(S) 10762, 10793, 10847

EXPLORATION

REFER ALSO TO CITATION(S) 10276

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 10871

10276 (MERC/TPR—76/1) **Comparison of conventional hydraulic and water/nitrogen foam fracturing in two Ohio Devonian Shale gas wells.** Frohne, K.H. (Energy Research and Development Administration, Morgantown, W.Va. (USA). Morgantown Energy Research Center). Feb 1976. 16p. Dep. NTIS $3.50.

The current natural gas supply problems in the United States are encouraging research into new or underdeveloped gas sources. One such source is the Devonian Shale sequence of Kentucky, West Virginia, Pennsylvania, and Ohio. These thick shale deposits contain large gas resources, but have not been fully exploited because of the severely restricted gas well flow rates. Shale wells must be artificially stimulated to improve gas deliverability to a commercial level, and research is under way to develop a stimulation method suited to the Devonian Shale. This report describes a performance comparison of two wells completed in the Shale near Youngstown, Ohio: one stimulated conventionally with hydraulic fracturing, the other with a nitrogen/water foam treatment. Both wells have comparable reservoir sections and received equivalently sized stimulation treatments. Drilling and fracture programs for both wells are discussed along with short-term gas production tests conducted to evaluate the fracture treatments. Early indications show that the foam fracturing method is better suited to the reservoir conditions found in the Devonian Shale, resulting in much faster fracturing fluid clean-up and higher initial gas production than the conventional water method. (auth)

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 10870, 10872

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 10839, 11438

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

REFER ALSO TO CITATION(S) 11421

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 10781, 10834, 10865, 10870, 10874

OIL SHALES AND TAR SANDS

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 10284

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 10848, 10849

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 10277, 11469

PROPERTIES AND COMPOSITION

10277 (UCRL—51957) **Pressure distribution in beds of oil shale rubble.** Carley, J.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Dec 1975. Contract W-7405-Eng-48. 16p. Dep. NTIS $3.50.

The Janssen equation for vertical distribution of pressure in beds of solid particles was applied to beds of broken shale. From a measured angle of repose of sample shale piles of 40°, frictional properties of shale beds were deduced, permitting the constants of the Janssen equation to be computed. Pressure distributions in beds 100, 200, and 250-ft square and up to 1400 ft deep were computed. The main finding was that bottom pressures (P/sub B/) at depths of 500 ft and more are only slightly affected by overburden pressure and asymptotically approach values given by P/sub B/ (psi) congruent to D (ft) where D is the width of the rubble well. Shale grade (density), rubble porosity, and uncertainties in coefficient of friction have only minor effects on the pressure distributions. Since the pressure exerted by unbroken overburdens may be expected to be small (probably less than 200 psi), pressures are not likely to exceed 300 psi anywhere in the bed. The major uncertainty is the temperature dependence of bed properties. (auth)

BY-PRODUCTS

REFER ALSO TO CITATION(S) 10855

MARKETING AND ECONOMICS

10278 Economics of oil shale operations featuring gas combustion retorting. Katell, S. (Bureau of Mines, Morgantown, WV). pp 121-122 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

Cost estimates are given for operation of a 50,000 barrel-per-day plant utilizing 30 gal/ton shale. A gas combustion retort is used, and an integrated system of underground mining, aboveground processing, and waste handling are included. The effects of inflation on the development of a cost analysis are discussed. (JGB)

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 10839, 10875, 11438

FISSION FUELS

RESERVES

REFER ALSO TO CITATION(S) 10880

10279 (GJO—109(76-1)) **Survey of lands held for uranium exploration, development, and production in fourteen western states in the six month period ending June 30, 1975.** (Bendix Field Engineering Corp., Grand Junction, Colo. (USA)). Dec 1975. Contract AT(05-1)-1664. 32p. Dep. NTIS $4.00.

Tabulated data are presented on land distribution by ownership, distribution by states, distribution by land category, and land control by county and state. (JSR)

10280 (GJO—110(76)) **Subjective probability appraisal of uranium resources in the state of New Mexico.** Ellis, J.R.; Harris, D.P.; VanWie, N.H. (Energy Research and Development Administration, Grand Junction, Colo. (USA). Grand Junction Office). Dec 1975. 103p. Dep. NTIS $5.50.

This report presents an estimate of undiscovered uranium resources in New Mexico of 226,681,000 tons of material containing 455,480 tons U_3O_8. The basis for this estimate was a survey of expectations of 36 geologists, in terms of subjective probabilities of number of deposits, ore tonnage, and grade. Weighting of the geologists' estimates to derive a mean value used a self-appraisal index of their knowledge within the field. Detailed estimates are presented for the state, for each of 62 subdivisions (cells), and for an aggregation of eight cells encompassing the San Juan Basin, which is estimated to contain 92 percent of the undiscovered uranium resources in New Mexico. Ore-body attributes stated as probability distributions enabled the application of Monte Carlo methods to the analysis of the data. Sampling of estimates of material and contained U_3O_8 which are provided as probability distributions indicates a 10 percent probability of there being at least 600,000 tons U_3O_8 remaining undiscovered in deposits virtually certain to number between 500 and 565. An indicated probability of 99.5 percent that the ore grade is greater than 0.12 percent U_3O_8 suggests that this survey may not provide reliable estimates of the abundance of material in very low-grade categories. Extrapolation to examine the potential for such deposits indicates more than 1,000,000 tons U_3O_8 may be available down to a grade of 0.05 percent U_3O_8. Supplemental point estimates of ore depth and thickness allowed derivative estimates of cost of development, extraction, and milling. 80 percent of the U_3O_8 is estimated to be available at a cost less than $15/lb (1974) and about 98 percent at less than $30/lb. (auth)

10281 (GJO—1649) **Comparative study of the geostatistical ore reserve estimation method over the conventional methods.** Kim, Y.C.; Knudsen, H.P. (Arizona Univ., Tucson (USA)). 31 Aug 1975. Contract AT(05-1)-1649. 101p. Dep. NTIS $5.50.

Part I contains a comprehensive treatment of the comparative study of the geostatistical ore reserve estimation method over the conventional methods. The conventional methods chosen for comparison were: (a) the polygon method, (b) the inverse of the distance squared method, and (c) a method similar to (b) but allowing different weights in different directions. Briefly, the overall result from this comparative study is in favor of the use of geostatistics in most cases because the method has lived up to its theoretical claims. A good exposition on the theory of geostatistics, the adopted study procedures, conclusions and recommended future research are given in Part I. Part II of this report contains the results of the second and the third study objectives, which are to assess the potential benefits that can be derived by the introduction of the geostatistical method to the current state-of-the-art in uranium reserve estimation method and to be instrumental in generating the acceptance of the new method by practitioners through illustrative examples, assuming its superiority and practicality. These are given in the form of illustrative examples on the use of geostatistics and the accompanying computer program user's guide. (LK)

10282 (PB—238658) **Assessment of uranium and thorium resources in the United States and the effect of policy alternatives. Final report.** Burnham, J.B.; Brown, R.E.; Enderlin, W.I.; Hanson, M.S.; Hartley, J.N. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1974. Contract NSF-C914. 223p. NTIS $7.25.

The principal objectives of the study were to analyze United States uranium and thorium resources; examine the state-of-the-art of uranium exploration, mining, milling, and environmental practices; and examine the effects of alternative governmental policy options on the price and availability of uranium. (GRA)

10283 (PB—241629) **Selected bibliography pertaining to uranium occurrence in eastern New Mexico and west Texas and nearby parts of Colorado, Oklahoma, and Kansas. Interim report.** Finch, W.I.; Wright, J.C.; Sullivan, M.W. (Geological Survey, Denver, Colo. (USA)). 1975. 100p. (USGS-GD—75/003). NTIS $4.75.

Nearly 500 selected references to uranium and to stratigraphy, structure, and groundwater geology related to uranium-bearing formations in eastern New Mexico and West Texas and nearby parts of Colorado, Kansas, and Oklahoma are indexed topically and geographically. The list is nearly complete through 1972 and contains some references with later dates. (GRA)

10284 (TID—27001) **Summary of reserve and resource data on coal, uranium, and oil shale in the states of Michigan, Ohio, Kentucky, Tennessee, West Virginia, North Dakota, South Dakota, Montanta, Wyoming, Colorado, and Utah.** Anderson, J.J.; Feldmann, R.M.; Palmer,D.F. 12 May 1975. 61p. American Petroleum Inst., Kent, OH.

A section is devoted to each state, each section including a contents and summary statement, resource-exhibition map, and tabulated data. 38 references. (JGB)

EXPLORATION

10285 (AEC-RID—4) **Magnetic susceptibility and geochemical relationships as uranium prospecting guides.** Ellis, J.R.; Austin, S.R.; Droullard, R.F. (Energy Research and Development Administration, Grand Junction, Colo. (USA). Grand Junction Office). Nov 1968. 26p. Dep. NTIS $4.00.

Select chemical and physical variables for 48 observations along a Wyoming ground traverse are compared statistically by use of a correlation program written for the IBM 1401. A comparison of the airborne gamma spectrometry with the ground data is also presented. Highly significant correlations exist between U_3O_8 or eU_3O_8 and eTh, eK, loss on ignition, and a significant correlation with combined P and V. Magnetic susceptibility has a highly significant correlation with Fe, Mn and negatively with eU_3O_8. The negative correlation with uranium offers a possible prospecting method to delineate areas favorable for uranium. (auth)

10286 (DPST—75-138-1) **Savannah River Laboratory quarterly report, January—March 1975. Hydrogeochemical and stream sediment reconnaissance: eastern United States. National Uranium Resource Evaluation Program.** (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 32p. Dep. NTIS $4.00.

The National Uranium Resource Evaluation (NURE) program was begun in the spring of 1973 to stimulate commercial uranium exploration in an attempt to meet the rapidly increasing national demand for uranium. This program was established to evaluate domestic uranium resources in the continental United States and to identify areas favorable for uranium exploration. In 1975, the Savannah River Laboratory accepted responsibility for hydrogeochemical and stream sediment reconnaissance of twenty-five states in the eastern United States. The distribution of uranium and associated trace elements in surface and underground waters and stream sediments will be systematically determined, and the data will be processed to locate favorable areas for the discovery of uranium districts with potential for commercial development.

10287 (PB—240155) **Detection and delineation of faults by surface resistivity measurements, Schwartzwalder Mine, Jefferson County, Colo. Report of investigations, 1974.** Stahl, R.L. (Bureau of Mines, Denver, Colo. (USA). Denver Mining Research Center). Dec 1974. 33p. (BM-RI—7975). NTIS $3.75.

Comprehensive field tests were made at the Schwartzwalder Mine, Jefferson County, Colorado, to determine whether surface geophysical techniques could be used to detect and delineate faults in uranium deposits. The tests included seismic refraction, magnetometer, electrical resistivity, airborne infrared thermal scanning and airborne photography. Of the several geophysical techniques tested in the field, horizontal resistivity profiling with electrode spacings in the range 10 to 15 feet was most diagnostic of faults. The method is quick, cheap, highly accurate, and one that can be easily used by personnel employed by mining companies to detect and delineate faults. (GRA)

FEED PROCESSING

REFER ALSO TO CITATION(S) 10310

ENRICHMENT

10288 **Method of isotope separation by chemi-ionization.** Wexler, S.; Young, C.E. (to U.S. Energy Research and Development Administration). US Patent Application 580,499. Filed date 23 May 1975. 17p.

A method is given for separating specific isotopes present in an isotopic mixture by aerodynamically accelerating a gaseous compound to form a jet of molecules, and passing the jet through a stream of electron donor atoms whereby an electron transfer takes place, thus forming negative ions of the molecules. The molecular ions are then passed through a radiofrequency quadrupole mass filter to separate the specific isotopes. This method may be used for any compounds having a sufficiently high electron affinity to permit negative ion formation, and is especially useful for the separation of plutonium and uranium isotopes. (auth)

GASEOUS DIFFUSION

10289 (CONF-751134—) **Uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Nuclear Fuel Cycle and Production; Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Oak Ridge Operations Office). 1975. 116p. Dep. NTIS $5.50.

From Uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

Eight papers were presented. Each has been abstracted and indexed separately. (JGB)

10290 (CONF-751134—, pp 1-6) **Review of FY 1975 operations.** Sullivan, E.R. Jr. (Energy Research and Development Administration, Oak Ridge, TN). 1975.

From Uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In Uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975.

Gaseous diffusion plant operations for fiscal year 1975 are emphasized, with consideration to fiscal year 1976 and the long-term picture. The effects of the increased and reduced supply of power on production of enriched uranium are evaluated. (JGB)

10291 (CONF-751134—, pp 7-16) **Results of expanded contract offer.** Huffman, F.C. (Energy Research and Development Administration, Oak Ridge, TN). 1975.

From Uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In Uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975.

Recent delays and cancellations of reactor projects have reduced the utilities' needs for previously contracted enriched uranium. As a result requests were made to US-ERDA for renegotiation of long-term fixed-commitment contracts. Contractors were given the option of reducing or canceling their original commitments; 193 out of 247 contract holders desired to make some change in their contracts. Summaries of contract modifications are tabulated. (JGB)

10292 (CONF-751134—, pp 17-26) **ERDA gaseous diffusion plants operational considerations.** Thomas, D.C. (Energy Research and Development Administration, Washington, DC). 1975.

From Uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In Uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975.

Factors that determine enrichment plant tails assay and directly affect US-ERDA's commitments to supply enriched uranium are discussed. Two options that would permit a customer to avoid possible future high tails assays are suggested. (JGB)

10293 (CONF-751134—, pp 27-40) **Alternate ERDA operating plans.** Parks, J.W. (Energy Research and Development Administration, Oak Ridge, TN). 1975.

From Uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In Uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975.

Variables associated with the operation of a gaseous diffusion facility are discussed. Particular emphasis is placed on the probability of power reactor recycling of Pu, an increase in transaction tails assay in the gaseous diffusion process, and the availability of electric power. Four alternate operating plans are summarized. (JGB)

10294 (CONF-751134—, pp 41-55) **Uranium requirements and supply outlook.** Patterson, J.A. (Energy Research and Development Administration, Washington, DC). 1975.

From Uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In Uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975.

The effects of recent rescheduling of US-ERDA's contract commitments for enriched uranium on uranium requirements for the various enrichment plant operating plans are reviewed. Procurement arrangements for U are examined, and the capability of the domestic industry in meeting these needs as well as the possible use of foreign U are considered. (JGB)

10295 (CONF-751134—, pp 57-66) **Buildup of ^{236}U in the gaseous diffusion plant product.** Ford, J.S. (Energy Research and Development Administration, Oak Ridge, TN). 1975.

From Uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In Uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975.

A generalized projection of the average annual ^{236}U concentration that can be expected in future enriched uranium product from the US-ERDA gaseous diffusion plants when reprocessed fuels become available for cascade feeding is given. It is concluded that the buildup of ^{236}U is not an ever-increasing function, but approaches a limiting value. Projected concentrations result in only slight separative work losses and present no operational problem to ERDA in supplying light water reactor requirements. The use of recycle uranium from power reactor spent fuels will result in significant savings in natural uranium feed. (JGB)

10296 (CONF-751134—, pp 67-92) **Gaseous diffusion operations.** Sommerfield, K.W. (Energy Research and Development Administration, Oak Ridge, TN). 1975.

From Uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In Uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975.

Steps involved in the gaseous diffusion process for enriching uranium are discussed. Operating experience of facilities at Paducah, Oak Ridge, and Portsmouth is outlined. (JGB)

10297 (CONF-751134—, pp 93-106) **Status report on CIP/CUP progress.** Larkin, W.J. (Energy Research and Development Administration, Oak Ridge, TN). 1975.

From Uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

In Uranium enrichment conference, Oak Ridge, Tennessee, November 11, 1975.

Work on the Cascade Improvement Program (CIP) and the Cascade Uprating Program (CUP) continues basically on schedule. When completed the productive capability of the gaseous diffusion facilities at Paducah, Oak Ridge, and Portsmouth will be increased by 60 percent. (JGB)

10298 (K—1839) **Behavior of the minor uranium isotopes in separation cascades. Part V. Review and appraisal.** Blumkin, S.; Von Halle, E. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 19 Jan 1976. Contract W-7405-eng-26. 33p. Dep. NTIS $5.00.

Part V is the final chapter of the completion report for this study. The results of the calculations made to determine the behavior of the minor uranium isotopes (U-234 and U-236) in separation cascades and the results of the two plant tests made to substantiate the validity of the calculations are reviewed briefly. Based on the fact that the U-234 and U-236 concentrations rela-

tive to that of U-235 in cascade withdrawal streams reflect the cascade flowsheet, it is concluded that the use of the minor isotope concentration measurements in cascade withdrawal streams, which is usually referred to by the acronym, MIST, is a potentially valuable adjunct to material accounting for safeguarding a U-235 enrichment cascade. A characteristic of MIST which qualifies it particularly for safeguards application under the NPT is the fact that its use is entirely non-intrusive with regard to process technology and proprietary information. The usefulness of MIST and how it may be applied are discussed briefly. To conclude this appraisal of MIST an enumeration is made of the capabilities that a safeguards inspection team would have to possess in order to apply MIST. (auth)

10299 **Stage design.** Shacter, J. (to U.S. Energy Research and Development Administration). US Patent 3,925,036. 9 Dec 1975. Filed date 23 Mar 1951. 6p.
PAT-APPL-217,116.

A method is described of cycling gases through a plurality of diffusion stages comprising the steps of admitting the diffused gases from a first diffusion stage into an axial compressor, simultaneously admitting the undiffused gases from a second diffusion stage into an intermediate pressure zone of said compressor corresponding in pressure to the pressure of said undiffused gases, and then admitting the resulting compressed mixture of diffused and undiffused gases into a third diffusion stage.

10300 **Method of recovering uranium hexafluoride.** Schuman, S. (to U.S. Energy Research and Development Administration). US Patent 3,925,536. 9 Dec 1975. Filed date 19 Jun 1947. 6p.
PAT-APPL-755,755.

A method of recovering uranium hexafluoride from gaseous mixtures which comprises adsorbing said uranium hexafluoride on activated carbon is described.

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 10345, 11108

10301 (DOCKET-701319—5) **Test and Research Reactor Fuel Element Fabrication Plant. IE inspection report No. 75-09 and reply.** (United States Nuclear, Inc., Oak Ridge, Tenn.). 3 Feb 1976. 18p. Dep. NTIS $3.50.

Copies of the following documents relating to U. S. Nuclear, Inc., Docket No. 70-1319 are presented: Letter to U. S. Nuclear, Inc. from J. T. Sutherland dated February 3, 1976; Letter to N. C. Moseley from U. S. Nuclear, Inc. dated January 28, 1976; Letter to N. C. Moseley from U. S. Nuclear, Inc. dated January 19, 1976; Letter to U. S. Nuclear, Inc. from N. C. Moseley dated December 22, 1975; and Region II Inspection Report No. 70-1319/75-9. (LK)

10302 (HEDL-SA—9045) **Dose rate analyses for fast reactor fuel manufacturers.** Smith, R.C.; Strode, J.N.; Brackenbush, L.W.; Faust, L.G. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1976. 13p. (CONF-750607—42). Dep. NTIS $3.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

An early appraisal of the radiation exposure situation in the fabrication of plutonium enriched mixed-oxide fuels for fast reactors is presented. Radiation data are presented on fuel process operations measured under actual operating conditions using plutonium containing up to 19 wt percent ^{240}Pu. (LK)

10303 (NUREG—0010) **Standard format and content of license applications for plutonium processing and fuel fabrication plants.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Standards Development). Jan 1976. 112p. (REG/G—3.39(1-76)). NTIS $5.50.

The standard format suggested for use in applications for licenses to possess and use special nuclear materials in Pu processing and fuel fabrication plants is presented. It covers general description of the plant, summary safety assessment, site characteristics, principal design criteria, plant design, process systems, waste confinement and management, radiation protection, accident safety analysis, conduct of operations, operating controls and limits, and quality assurance. (JSR)

10304 (ORNL—5078, pp 163-167) **Salt production.** Daley, F.L.; Horton, R.W. Feb 1976.

In Molten-salt reactor program. Semiannual progress report for period ending August 31, 1975.

Experience with units operated for production of salt mixtures required for experiments in the MSR program is summarized. (JRD)

10305 (ORNL/TM—5133) **Uranium dispersion in the coating of weak-acid-resin-deprived HTGR fuel microspheres.** Weber, G.W.; Beatty, R.L.; Tennery, V.J.; Lackey, W.J. Jr. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 44p. Dep. NTIS $5.50.

The current reference HTGR recycle fuel particle is a UO_2/UC_2 kernel with a Triso coating comprising a low-density pyrocarbon (PyC) buffer, a high-density PyC inner LTI coating, SiC, and a high-density PyC outer LTI. The kernel is fabricated from a weak-acid ion exchange resin (WAR). Microradiographic examination of coated WAR particles has demonstrated that considerable U can be transferred from the kernel to the buffer coating during fabrication. Investigation of causes of fuel dispersion has indicated several different factors that contribute to fuel redistribution if not properly controlled. The presence of a nonequilibrium UC/sub 1-x/O/sub x/ (0 less than or equal to x less than or equal to 0.3) phase had no significant effect on initiating fuel dispersion. Gross exposure of the completed fuel kernel to ambient atmosphere or to water vapor at room temperature produced very minimal levels of dispersion. Exposure of the fuel to perchloroethylene during buffer and inner LTI deposition produced massive redistribution. Fuel redistribution observed in Triso-coated particles results from permeation of the inner LTI by HCl during SiC deposition. As the decomposition of CH_3Cl_3Si is used to deposit SiC, chlorine is readily available during this process. The permeability of the inner LTI coating has a marked effect on the extent of this mode of fuel dispersion. LTI permeability was determined by chlorine leaching studies to be a strong function of density, coating gas dilution, and coating temperature but relatively unaffected by application of a seal coat, variations in coating thickness, and annealing at 1800°C. Mechanical attrition of the kernels during processing was identified as a potential source of U-bearing fines that may be incorporated into the coating in some circumstances. (auth)

10306 **Gamma-ray absorptometer for nuclear fuel evaluation.** Ayer, J.E.; Schmitt, D.R. (Argonne National Lab., IL). *Nucl. Technol.*; **27**: No. 3, 442-448(Nov 1975).

A gamma-ray absorptometer system used to determine the density distribution in nuclear fuel rods was designed, assembled, and operated. The absorptometer emits a collimated beam from an irradiated thulium source that is transmitted through a rotating fuel rod. The photons in the attenuated beam are counted and the counts are recorded on teletype tape. The tape output for each fuel rod inspected is used to punch counting data into card form. Data cards from a series of fuel rods are positioned in a FORTRAN-language source program. A computer then calculates and prints such information as the standard deviation due to counting and to density variations; the maximum, minimum, and average counts; and the density equivalent of each count. Calculated density is then programmed into an x-y plotter and displayed versus rod length. The system was found to be sensitive to changes of less than 1 percent of theoretical density with 95 percent confidence of detecting changes greater than 2 percent of theoretical. The design objectives of compactness, ease of operating, and amenability to use of modern computational techniques were achieved. (auth)

10307 **Fuel particle inspection with an irradiated microsphere gamma analyzer.** Valentine, K.H.; Long, E.L. Jr. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; **22**: 213-214(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10308 **Resin-based preparation of HTGR fuels: uranium loading development studies.** Haas, P.A. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; **22**: 317-318(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 10330, 10332, 10344, 10508, 10527, 10549

10309 (ARH-ST—128A) **Research and Engineering Division semiannual report. KK process development and technology, November 1, 1974—April 30, 1975.** Fox, R.D. (ed.). (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Aug 1975. Contract E(45-1)-2130. 125p. Dep. NTIS $7.00.

Research and engineering activities with the goal of improving the performance of the plutonium processing and waste management programs being operated by the Atlantic Richfield Hanford Company are reported. (auth)

10310 (CONF-760203—1) **Recovery of uranium from wet process phosphoric acid by solvent extraction.** Hurst, F.J. (Oak Ridge National Lab., Tenn. (USA)). 1976. 34p. Dep. NTIS $5.00.

From AIME annual meeting; Las Vegas, Nevada, United States of America *USA* (22 Feb 1976).

The OPPA process offers three potential advantages over the DEPA-TOPO process. The OPPA extractant is much less expensive and has a higher extraction power for uranium than the DEPA-TOPO solvent. In addition it extracts U(IV), the prevailing oxidation state of uranium in wet-process phosphoric acid and this eliminates the liquor oxidation step required in the DEPA-TOPO process. However, the DEPA-TOPO solvent is known to be extremely stable and this process has been successfully demonstrated on a pilot-plant scale at phosphate plants. It is understood that several companies are planning to commercialize this process in the near future. On the other hand, the potentially more attractive OPPA process has not been proven in a pilot plant operation and some questions about the solubility and stability of the OPPA need to be answered. Because of the wide spread interest in this process, a program was started in cooperation with Mobil and Allied Chemical companies to study this extractant, to identify and isolate the material that solubilizes the mono- and diacids, and to determine the optimum concentration and ratios for uranium extraction. In addition, a long-term cyclic test is planned to better define solubility losses and stability of the extractant. Consideration will also be given to improving the recovery of uranium lost to the gypsum during calcination. 12 figures. (auth)

10311 (DOCKET-50332—56) **Barnwell Nuclear Fuel Plant. License application, FSAR, amendment 14.** (Allied-Gulf Nuclear Services, Barnwell, S.C. (USA)). Nov 1975. 156p. Dep. NTIS $6.75.

This Amendment 14 to the application for an operating license consists of Amendment 7 to the FSAR, which is principally a revision of Section 17.2, Operational Quality Assurance Program. Other miscellaneous revisions are also included, including a ruthenium flowsheet, installation of plutonium nitrate storage cell PNC-2, dissolver criticality, and meteorological data. (DLC)

10312 (DOCKET-701729—7) **Fuel Receiving and Storage Station. Nuclear Regulatory Commission's final environmental statement.** (Allied-General Nuclear Services, Barnwell, S.C. (USA)). Jan 1976. 189p. (NUREG—0008). Dep. NTIS $7.50.

The following items are covered: the site, the station, environmental effects of site preparation and station construction, environmental effects of station operation, effluent and environmental monitoring programs, environmental effects of accidents, need for BFRSS, benefit-cost analysis of alternatives, generic environmental impact statements, and discussion of and response to comments received on the draft environmental statement. (LK)

10313 (DOCKET-701729—8) **Fuel Receiving and Storage Station. Nuclear Regulatory Commission's safety evaluation report.** (Allied-General Nuclear Services, Barnwell, S.C. (USA)). Jan 1976. 58p. (NUREG—0009). Dep. NTIS $4.50.

The safety evaluation report covers design of structures, components, equipment, and systems; nuclear criticality safety; radiological safety; accident analysis; conduct of operations; quality assurance; common defense and security; financial qualifications; financial protection and indemnity requirements; and technical specifications. (LK)

10314 (ICP—1052) **Final safety analysis report for the irradiated fuels storage facility.** Bingham, G.E.; Evans, T.K. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office). Jan 1976. Contract E(10-1)-1375. 169p. Dep. NTIS $8.50.

A fuel storage facility has been constructed at the Idaho Chemical Processing Plant to provide safe storage for spent fuel from two commercial HTGR's, Fort St. Vrain and Peach Bottom, and from the Rover nuclear rocket program. The new facility was built as an addition to the existing fuel storage basin building to make maximum use of existing facilities and equipment. The completed facility provides dry storage for one core of Peach Bottom fuel (804 elements), $1^1/_2$ cores of Fort St. Vrain fuel (2200 elements), and the irradiated fuel from the 20 reactors in the Rover program. The facility is designed to permit future expansion at a minimum cost should additional storage space for graphite-type fuels be required. A thorough study of the potential hazards associated with the Irradiated Fuels Storage Facility has been completed, indicating that the facility is capable of withstanding all credible combinations of internal accidents and pertinent natural forces, including design basis natural phenomena of a 10,000 year flood, a 175-mph tornado, or an earthquake having a bedrock acceleration of 0.33 g and an amplification factor of 1.3, without a loss of integrity or a significant release of radioactive materials. The design basis accident (DBA) postulated for the facility is a complete loss of cooling air, even though the occurrence of this situation is extremely remote, considering the availability of backup and spare fans and emergency power. The occurrence of the DBA presents neither a radiation nor an activity release hazard. A loss of coolant has no effect upon the fuel or the facility other than resulting in a gradual and constant temperature increase of the stored fuel. The temperature increase is gradual enough that ample time (28 hours minimum) is available for corrective action before an arbitrarily imposed maximum fuel centerline temperature of 1100°F is reached. (LK)

10315 (ORNL—5078, pp 140-162) **Fuel processing for molten-salt reactors.** Hightower, J.R. Jr. Feb 1976.

In Molten-salt reactor program. Semiannual progress report for period ending August 31, 1975.

Research devoted to development of processes for the isolation of protactinium and for the removal of fission products from molten-salt breeder reactors is reported. During this report period, engineering development progressed on continuous fluorinators for uranium removal, the metal transfer process for rare-earth removal, the fuel reconstitution step, and molten salt—bismuth contactors to be used in reductive extraction processes. The metal transfer experiment MTE-3B was started. In this experiment all parts of the metal transfer process for rare-earth removal are demonstrated using salt flow rates which are about 1 percent of those required to process the fuel salt in a 1000-MW(e) MSBR. During this report period the salt and bismuth phases were transferred to the experimental vessels, and two runs with agitator speeds of 5 rps were made to measure the rate of transfer of neodymium from the fluoride salt to the Bi—Li stripper solution. The uranium removed from the fuel salt by fluorination must be returned to the processed salt in the fuel reconstitution step before the fuel salt is returned to the reactor. An engineering experiment to demonstrate the fuel reconstitution step is being installed. In this experiment gold-lined equipment will be used to avoid introducing products of corrosion by UF_6 and UF_5. Alternative methods for providing the gold lining include electroplating and mechanical fabrication. (JRD)

10316 (ORNL-TM—4870) **Engineering development studies for molten-salt breeder reactor processing No. 20.** Hightower, J.R. Jr. (comp.) . (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 50p. Dep. NTIS $5.50.

Autoresistance heating runs were made with the AHT-3 equipment for the continuous fluorinator development. Installation of all equipment was completed for the metal transfer experiment MTE-3B in which steps in the metal transfer process for removing rare-earth fission products from breeder reactor fuel salt will be studied. Samples of the salt and bismuth phases (at the three interfaces) from previously operated MTE-3 were analyzed to identify any interfacial impurities. The seventh tracer run, TSMC-7, has been completed in the mild steel contactor installed in the salt—bismuth flowthrough facility. TSMC-7 was performed after 1 mg of $^{237}U_3O_8$ and 11 mg of MgO were added to the salt in the salt feed tank. Salt and bismuth flow rates were 152 and 170 cc/min with an agitator speed of 68 rpm. Results from the flowing stream samples indicate that the salt-phase mass transfer coefficient was 0.0057 +- 0.0042 cm/s. Data from experiments performed in the water/mercury contactor were reanalyzed to determine if the apparent change in mass transfer coefficient was due to the controlling resistance to mass transfer changing from one phase to the other. For the fuel reconstitution development, equipment is described for absorbing UF_6 gas into a flowing salt stream containing UF_4 and reducing the resultant UF_5 to UF_4 by hydrogenation. 19 figures, 3 tables, 13 references. (DLC)

10317 (ORNL-tr—2999) **Electrolytic techniques in the Purex process.** Schmieder, H.; Baumgaertner, F.; Goldacker, H.; Hausberger, H. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Heisse Chemie). Translation of of KFK—2082. 76p. Dep. NTIS $5.00.

A 16-stage electrolytic mixer-settler, operating without diaphragm, was constructed on the basis of investigations on corrosion rates and electrolytic mass transfer at different electrode materials. The mixer-settler casing was made of titanium. The Pu—U separation (1B-Battery) and the Pu back-extraction by electrolytic reduction (2B-Battery) were successfully tested during more than 1000 hours of operation. The mass transfer coefficients obtained for uranium proved that no fundamental difficulties should arise from the scaleup of the apparatus. Experiments with an electrolytic pulse-column showed favorable mass transfer coefficients, which are comparable to those of the tested mixer-settler. Flowcells were constructed and successfully tested on the basis of laboratory experiments concerning the anodic oxidation of plutonium between the cycles of the Purex process. (auth)

10318 Volatilization of iodine from nitric acid using peroxide. Cathers, G.I.; Shipman, C.J. (to U.S. Energy Research and Development Administration). US Patent 3,914,388. 21 Oct 1975. Filed date 11 Sep 1973. 4p.
PAT-APPL-396,336.

A method for removing radioactive iodine from nitric acid solution by adding hydrogen peroxide to the solution while concurrently holding the solution at the boiling point and distilling hydrogen iodide from the solution is reported.

10319 Modifications of the SEPHIS computer program for calculations of the acid thorex solvent extraction system. Rainey, R.H.; Watson, S.B. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; **22**: 315-317(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 10589

10320 (SAND—75-0248A) **Transportation environment data bank index.** Davidson, C.A.; Foley, J.T. (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1976. Contract AT(29-1)-789. 39p. Dep. NTIS $5.00.

In an effort to determine the environment intensities to which shipping containers will be exposed, a "Data Bank" of environmental information has been established by Sandia Laboratories, Division 1285 for the ERDA Division of Environmental Control Technology. This document is an index which can be used to request data of interest. (auth)

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 10601

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 10309

10321 (ARH—2075) **Hanford radiochemical site decommissioning demonstration program.** Nelson, D.C.;. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 9 Aug 1971. Contract E(45-1)-2130. 67p. Dep. NTIS $4.50.

A program is proposed for the innovation, development, and demonstration of technologies necessary to decommission the Hanford radiochemical plant area to the extent that the sites can have unrestricted public access. The five tasks selected for development and demonstration of restoration techniques were restoration of a burial ground, decommissioning of a separations plant, restoration of a separations plant waste interim storage tank farm, restoration of a liquid disposal area, and disposal of large contaminated equipment. Process development requirements are tabulated and discussed. A proposed schedule and estimated costs are given. (JSR)

10322 (BNWL—1952) **Nuclear Waste Management and Transportation quarterly progress report, July—September 1975.** Platt, A.M. (comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-1830. 51p. Dep. NTIS $5.45.

Progress is reported in the following areas of research: advanced methods for management and disposal of radioactive wastes; decontamination and densification of chop—leach cladding residues; pyrolysis—incineration of combustible alpha wastes; tritium separation and fixation; disposition of retired contaminated facilities at Hanford; and transportation safety studies. (JGB)

10323 (PB—240739) **The effects of air and water pollution controls on solid waste generation, 1971—1985. Executive summary. Final report.** Stone, R. (Stone (Ralph) and Co., Inc., Los Angeles, Calif. (USA)). Dec 1974. Contract EPA-68-03-0244. 84p. NTIS $4.75.

The effects of air and water pollution controls on solid waste generation were evaluated. The solid wastes from pollution control were identified for individual industrial sectors by their original air or water pollutant constituents, and the treatment process applied. The wastes were categorized by type and by location (rural or urban). Total solid wastes from pollution control activities were estimated for 1971 and projected for 1985. Particulates and sulfur oxides were identified as the major air pollutants capable of generating solid wastes when treated; suspended solids and biological oxygen demand were identified as the principal means of estimating the impact of water pollution control on solid wastes. Important sectors generating solid wastes included power plants, paper and pulp, chemicals, and cement and clay, steel furnaces, nonferrous smelting and refining, sewerage systems, and hazardous wastes from uranium mining. Mine tailing ponds were estimated to be a greater source than all the above sources but were not seen to be a landfill disposal problem. (GRA)

10324 Method for utilizing decay heat from radioactive nuclear wastes. Busey, H.M. (to U.S. Energy Research and Development Administration). US Patent 3,911,684. 14 Oct 1974. Filed date 29 Aug 1974. 4p.
PAT-APPL-501,726.

Management of radioactive heat-producing waste material while safely utilizing the heat thereof is accomplished by encapsulating the wastes after a cooling period, transporting the capsules to a facility including a plurality of vertically disposed storage tubes, lowering the capsules as they arrive at the facility into the storage tubes, cooling the storage tubes by circulating a gas thereover, employing the so heated gas to obtain an economically beneficial result, and continually adding waste capsules to the facility as they arrive thereat over a substantial period of time.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 10357, 10618, 11152

10325 (BNL—20898) **Fixation of aqueous tritiated waste in polymer impregnated concrete and in polyacetylene.** Colombo, P.; Neilson, R. Jr.; Steinberg, M. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 21p. (CONF-750989—4). Dep. NTIS $3.50.

From International conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (30 Sep 1975).

Tritiated aqueous waste can be used to hydrate hydraulic cement producing a concrete that contains a network of interconnected porosity. Such a product is subject to water intrusion and subsequent tritium loss by leaching and exchange. Techniques have been developed to impregnate this porosity with styrene monomer which is then polymerized in situ, resulting in a concrete that is essentially impermeable while its strength, durability, and resistance to chemical attack are significantly improved. Tritium bulk leach rates as low as 1.68×10^{-4} g/(cm^2-day) have been measured for polymer-impregnated concrete in water. An adsorbent additive can be incorporated to increase the specific tritiated waste loading of the concrete, Depending upon the formulations, these composites incorporate 5.8 to 8.3 liters HTO per cubic foot. Tritiated aqueous waste can also be fixed in polymeric form as polyacetylene through reaction with calcium carbide to form tritiated acetylene which is subsequently polymerized. Acetylene polymerization is accomplished by either ^{60}Co gamma irradiation or thermal catalysis over cupric oxide. The tritiated polyacetylene produced can contain up to 50 atomic percent tritium and is essentially non-leachable, insoluble, thermally stable to 325°C, and chemically inert. The bulk leach rate of tritiated polyacetylene was determined to be of the order of 1.8×10^{-8} g/(cm^2-day). Radiolysis by ^{60}Co gamma irradiation results in a G value for hydrogen production of 0.15 molecules/100 eV. Tritiated polyacetylene can be incorporated as an aggregate in concrete, polymer concrete, or polymer impregnated concrete to form a monolithic solid. (auth)

10326 (BNWL—1949) **Research and development activities waste fixation program. Quarterly progress report, July—September 1975.** McElroy, J.L. (comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1976. Contract E(45-1)-1830. 87p. Dep. NTIS $6.00.

Engineering-scale in-canister melting tests were made to evaluate the use of silicon to prevent formation of water-soluble molybdate phases in melts. The tests demonstrated that silicon metal powder added to the feed stock effectively prevents formation of such phases. A test also showed that coatings of ZrO_2 or chromium carbide on stainless steel canisters prevent oxidation during the in-can melting process. Thermal analysis of canister design concepts examined effects of type of storage, use of fins, emissivity, canister size and cracks in glass. Pressurization tests show that all types of calcine can produce very high pressures within the canister unless the calcine is post-treated at temperatures greater than 850°C. Initial studies on the effects of alpha and recoil bombardment (from ^{244}Cm doping) on devitrification of waste-containing glass were completed. The devitrification behavior of a waste-bearing zinc orthosilicate glass is being studied using optical microscopy, electron microprobe, and x-ray diffraction examination. Fine calcine particles were agglomerated into

larger particles suitable for coating via chemical vapor deposition. Thermal stability tests of nickel and Cr_7C_3 coatings on waste calcine have been conducted, and deterioration has occurred at temperatures as low as 500°C. Waste-containing pellets were successfully coated by plasma spraying Al_2O_3 powder. Calculations indicate that plasma spraying of large pellets is feasible on a production scale. Seven scoping runs made with a disc pelletizer indicate that it can provide a simple, inexpensive process for making high-quality pellets from calcine-frit powders. Risk assessment was used to systematically identify dominant sequences for the accidental release of radionuclides during the solidification, basin storage, and rail transport activities of high-level waste management. (JGB)

10327 (CONF-750117—P2, pp 621-700) **High-level radioactive waste management.** Platt, A.M.; McElroy, J.L. (Battelle-Northwest Lab., Richland, WA). 1975.

From International symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In International symposium on nuclear power technology and economics. Volume II.

The major alternatives in waste management systems for the high-level wastes from commercial reprocessing plants are presented.

10328 (GA-A—13348) **Curium-244/neptunium-237 recovery from the Barnwell Nuclear Fuel Plant.** Carney, H.C. (ed.). (General Atomic Co., San Diego, Calif. (USA)). Feb 1975. Contract AT(04-3)-167. 366p. Dep. NTIS $10.50.

Curium-244 sesquioxide is a potentially economic fuel in heat sources for radioisotope thermoelectric generators, when recovered from LWR spent fuel. This study was completed to determine curium availability and cost from a full-scale recovery, processing, and encapsulation facility at the Barnwell Nuclear Fuel Plant (BNFP) site. Similar information was obtained for by-product neptunium-237. The separation facility is designed to process all of the high-level liquid waste (HLLW) from BNFP (5 tonnes of fuel per day) after 3 years' aging, with a curium recovery fraction of at least 80 percent and minimum product purity of 97 percent. The reference process flowsheet consists of the following steps: HLLW feed clarification by centrifugation; removal of plutonium, neptunium, and uranium by solvent extraction; acid destruction by reaction with sugar; a second clarification by centrifugation; curium purification by ion exchange; and waste disposal. The plant also includes curia fabrication and encapsulation facilities, and neptunia target rod fabrication facilities. Capital costs and the economics of Cm production are discussed. Overall risks associated with this program are considered sufficiently large to preclude a recommendation for a commercial business venture at this time. (JGB)

10329 (HEDL-TME—75-102) **Commercial Alpha Waste Program. Quarterly progress report, April, May, June 1975.** Cooley, C.R. (comp.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1975. Contract E(45-1)2170. 43p. Dep. NTIS $4.00.

This is the fifth Quarterly Progress Report on the Commercial Alpha Waste Program being conducted at the Hanford Engineering Development Laboratory (HEDL) for the Division of Nuclear Fuel Cycle and Production, United States Energy Research and Development Administration. Tests of new construction materials for the acid digester, and safety tests of compounds which may be present when processing wastes are discussed. The behavior of uranium in alpha wastes when processed by acid digestion is discussed. Data are presented on the effects of solids build-up on waste digestion rates. Commercial radioactive waste accumulations at burial grounds are presented. The use of infrared heaters for processing combustible materials is discussed. (auth)

10330 (SAND—75-5907) **Sandia solidification process: a broad range aqueous waste solidification method.** Lynch, R.W.; Dosch, R.G.; Kenna, B.T.; Johnstone, J.K.; Nowak, E.J. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 15p. (CONF-760310—1; SM—207/75). Dep. NTIS $3.50.

From IAEA symposium on the management of radioactive waste; Vienna, Austria (22 Mar 1976).

New ion-exchange materials of the hydrous oxide type were developed for solidifying aqueous radioactive wastes. These materials have the general formula M[M'/sub x/O/sub y/H/sub z/]/sub n/, where M is an exchangeable cation of charge +n and M' may be Ti; Nb; Zr, or Ta. Affinities for polyvalent cations were found to be very high and ion-exchange capacities large (e.g., 4.0—4.5 meq/g for $NaTi_2O_5H$ depending on moisture content). The effectiveness of the exchangers for solidifying high-level waste resulting from reprocessing light-water reactor fuel was demonstrated in small-scale tests. Used in conjunction with anion exchange resin, these materials reduced test solution radioactivity from approximately 0.2 Ci/ml to as low as approximately 2 nCi/ml. The residual radioactivity was almost exclusively due to ^{106}Ru and total α-activity was only a few pCi/ml. Alternative methods of consolidating the solidified waste were evaluated using nonradioactive simulants. Best results were obtained by pressure-sintering which yielded essentially fully dense ceramics, e.g., titanate/titania ceramics with bulk density as high as 4.7 g/cm³, waste oxide content as high as 1.2 g/cm³, and leach resistance comparable to good borosilicate glass. Based on the above results, a baseline process for solidifying high-level waste was defined and approximate economic analyses indicated costs were not prohibitive. Additional tests have demonstrated that, if desired, operating conditions could be modified to allow recovery of radiocesium (and perhaps other isotopes) during solidification of the remaining constituents of high-level waste. Preliminary tests have also shown that these materials offer promise for treating tank-stored neutralized wastes. (auth)

10331 (UNI—425) **Evaluation of weathered impregnated charcoals for retention of iodine and methyl iodide.** Bennett, E.C.; Strege, D.E. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 7 Nov 1975. 37p. Dep. NTIS $4.00.

The results are reported of a study to determine the effect of weathering and aging on the efficiency of some impregnated charcoals in absorbing and retaining halogens and organic halides. The purpose is to establish the optimum charcoal for use in the N Reactor confinement system. Charcoals exposed for six months in the Zone I ventilation system showed little change in the retention efficiencies for elemental iodine, but the methyl iodide retention was severely degraded in all cases. The loss of efficiency of methyl iodide retention was attributed to the accumulation of organic pollutants. (JSR)

10332 **Improved method for solidifying liquid radioactive wastes.** Berreth, J.R. (to U.S. Energy Research and Development Administration). US Patent Application 567,340. Filed date 11 Apr 1975. 7p.

The quantity of nitrous oxides produced during the solidification of liquid radioactive wastes containing nitrates and nitrites can be substantially reduced by the addition to the wastes of a stoichiometric amount of urea which, upon heating, destroys the nitrates and nitrites, liberating nontoxic N_2, CO_2 and NH_3. (auth)

10333 **Activation of water soluble amines by halogens for trapping radioiodine from air streams.** Deitz, V.R.; Blachly, C.H. (to U.S. Energy Research and Development Administration). US Patent Application 570,925. Filed date 22 Apr 1975. 7p.

Gas adsorbent charcoals impregnated with an aqueous solution of the reaction product of a tertiary amine and elemental iodine or bromine are better than 99 percent efficient in trapping $CH_3{}^{131}I$. The chemical addition of iodine or bromine to the tertiary amine molecule increases the efficiency of the impregnated charcoal as a trapping agent, and in conjunction with the high flash point of the tertiary amine raises the ignition temperature of the impregnated charcoal. (auth)

10334 (AD/A—006694) **Purification of gaseous discharges of radioactive aerosols and gases.** Przyborowski, S. 18 Feb 1975. Edited translation of Staatliche Zentrale fuer Strahlenschutz, Berlin. Report (East Germany), SZS—142, p15-19, Sep 1972. (FTD-HC—23-0750-75). 10p. NTIS $3.25.

The importance of a thorough testing of filter material used for the removal of aerosols from the exhaust air of nuclear power plants is noted. A method is presented for the assessment of penetration depending on particle size and flow rate. The results obtained are discussed. (GRA)

10335 **Thermal analysis of a fuel cladding repository pilot plant in salt.** Claiborne, H.C. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; **22**: 352(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10336 **Ceramics from ion exchangers: an approach to nuclear waste solidification.** Dosch, R.G. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.*; **22**: 355(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10337 **Consolidation and characterization of ion-exchange-derived nuclear waste ceramics.** Johnstone, J.K.; Meyer, R.T. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.*; **22**: 355-356(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10338 **Iodine retention during evaporative volume reduction.** Godbee, H.W.; Cathers, G.I.; Blanco, R.E. (to U.S. Energy Research and Development Administration). US Patent 3,920,577. 18 Nov 1975. Filed date 16 Jul 1974. 4p.
PAT-APPL-489,791.

An improved method for retaining radioactive iodine in aqueous waste solutions during volume reduction is disclosed. The method applies to evaporative volume reduction processes whereby the decontaminated (evaporated) water can be returned safely to the environment. The method generally comprises isotopically diluting the waste solution with a nonradioactive iodide and maintaining the solution at a high pH during evaporation.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 10326, 10327, 10329, 10649, 10946, 11034, 11467

10339 (BNWL-CC—887) **Earth sciences waste disposal investigations, January—June 1966.** Eliason, J.R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1966. Contract AT(45-1)-1830. 16p. Dep. NTIS $3.50.

An evaluation is given of the ground water contamination resulting from disposal of plant effluents at Hanford. Analytical results are presented for gross beta activity in the unconfined ground water aquifer and gross beta activity at depths in the ground water. Results are given where concentrations of radionuclides are above the routine detection limit for gross beta. The average concentrations detected during the previous report period are listed for comparison. (JSR)

10340 (LA—6202-M) **Computerized low-level waste assay system operation manual.** Jones, D.F.; Cowder, L.R.; Martin, E.R. (Los Alamos Scientific Lab., N.Mex. (USA)). Jan 1976. Contract W-7405-Eng-36. 40p. Dep. NTIS $5.00.

An operation and maintenance manual for the computerized low-level waste box counter is presented, which describes routine assay techniques as well as theory of operation treated in sufficient depth so that an experienced assayist can make nonroutine assays. In addition, complete system schematics are included, along with a complete circuit description to facilitate not only maintenance and troubleshooting, but also reproduction of the instrument if desired. Complete software system descriptions are included so far as calculational algorithms are concerned, although detailed instruction listings would have to be obtained from Group R-1 at LASL in order to make machine-language code changes. (auth)

10341 (ORNL-TM—5209) **Evaluation of waste disposal by shale fracturing.** Weeren, H.O. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 52p. Dep. NTIS $5.50.

The shale fracturing process is evaluated as a means for permanent disposal of radioactive intermediate level liquid waste generated at the Oak Ridge National Laboratory. The estimated capital operating and development costs of a proposed disposal facility are compared with equivalent estimated costs for alternative methods of waste fixation.

10342 (PB—241300) **A survey of the Farallon Islands radioactive waste disposal site. Summary report.** (Interstate Electronics Corp., Anaheim, Calif. (USA). Environmental Engineering Div.). Feb 1975. Contract EPA-68-01-0796. 23p. (IEC—446-OC-1649). NTIS $3.25.

The report is a summary of the August 1974 survey of a waste disposal site near the Farallon Islands that had been used between 1946 and 1966 for the disposal of radioactive waste materials. This survey was the first in which a deepwater (850) meter radioactive waste disposal site had been successfully relocated and subjected to a comprehensive survey. The U.S. Navy's CURV III, an unmanned remote controlled submersible, was used to investigate the condition of the containers. The report contains site location chart and high quality benthic color plates showing the condition of the containers. (GRA)

10343 **Measurement of transuranic solid wastes at the 10 nCi/g activity level.** Umbarger, C.J.; Cowder, L.R. (Los Alamos Scientific Lab., NM). *Nucl. Technol.;* **27**: No. 3, 500-510(Nov 1975).

Two nondestructive assay systems, the MEGAS and the Pancake Counter, for the measurement of transuranic contaminated solid wastes at 10-nCi/g activity levels, have been developed. These are NaI-based detection systems to be used specifically for low-density solid transuranic wastes. They are of value in effective implementation of new federal regulations pertaining to transuranic waste management in that they supplement the usual administrative decision making in waste handling. (auth)

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 10321, 10323, 10339, 10342, 10839, 11438, 11438

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 11122, 11456, 11467, 11479, 11592, 11596, 11609, 11618, 11619, 11620, 11621, 11622, 11626, 11630, 11631, 11643, 11644, 11645, 11646, 11647; 11648, 11649, 11650, 11651, 11652, 11657

10344 (DPSPU—75-30-13) **Explosion and fire in A-Line facility of the Savannah River Plant.** Burriss, W.H. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Sep 1975. Contract AT(07-2)-1. 4p. (CONF-751084—1). Dep. NTIS $3.50.

From ERDA safety conference; Batavia, Illinois, United States of America "USA" (2 Oct 1975).

During routine operations to reduce uranyl nitrate hexahydrate to uranium trioxide, an excessive amount of organic solution entered denitrator pots and ignited. Damage from the resulting explosion and fire amounted to about $300,000. No spread of contamination or serious injuries occurred. The facility has been restored to production with process modifications to prevent recurrence. (auth)

10345 (HEDL-TME—75-62) **Fast fuels radiation exposure measurements semi-annual progress report, July—December 1974.** Smith, R.C.; Strode, J.N.; Brackenbush, L.W.; Faust, L.G. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1974. Contract E(45-1)-2170. 27p. AT.

This is the first semi-annual progress report on the Fast Fuels Radiation Exposure Measurements program being conducted at the Hanford Engineering Development Laboratory (HEDL) for the Division of Reactor Research and Development (RRD). Data on occupational exposure and measurements of the radiations from fast-reactor mixed (UO_2-PuO_2) fuels are presented. Dose rate measurement data include; (a) gamma surface dose rates from mixed oxides as a function of the uranium dioxide dilution of plutonium dioxide, (b) neutron dose rates as a function of plutonium in mixed oxides, (c) dose rates from medium-exposure Pu (12 wt percent ^{240}Pu) and high-exposure Pu (19 wt percent ^{240}Pu) used in fuel fabrication through shielded and unshielded gloveboxes, and lead-loaded versus neoprene gloves, and (d) measurements of the neutron dose rates from 120 FFTF fuel pins. (auth)

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 10298, 11350

10346 (SAND—75-0595) **Graph theoretic models of theft problems. I. The basic theft model.** Hulme, B.L. (Sandia Labs., Albuquerque, N.Mex. (USA)). Nov 1975. Contract AT(29-1)-789. 28p. Dep. NTIS $5.00.

This report shows how weighted graphs may be used to study the vulnerability of a fixed-site security system to theft. A general way of constructing graph theoretic models is presented together with variations in the types of weight functions which will produce different specific models designed to accommodate various physical situations. One specific model is studied in detail, the basic theft model, in which the weights are constants independent of the direction of travel. This model admits solution by a Dijkstra-type algorithm, and hence the run time is roughly proportional to the square of the number of nodes in the graph. (auth)

10347 **Adversary characterization for security system evaluation.** Suber, L.A. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.;* **22**: 340-341(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10348 **ERDA demonstration of safeguards for fuel cycle materials and facilities.** Lyon, H.E.; Bartels, W.C. (Energy Research and Development Administration, Washington, DC). *Trans. Am. Nucl. Soc.;* **22**: 341-342(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10349 Continuous inventory in SNM storage facilities. Chambers, W.H. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.*; **22**: 343-344(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10350 Use denial of special fissionable materials. Zehr, S.W.; Mar, R.W. (Sandia Labs., Livermore, CA). *Trans. Am. Nucl. Soc.*; **22**: 344(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

FUSION FUELS

PROCESSING

10351 Fabrication of $LiD_{0.5}T_{0.5}$ microspheres for use as laser fusion targets. Carstens, D.H.W.; Farnum, E.H.; Fries, R.J.; Sheinberg, H. (Los Alamos Scientific Lab., N.Mex. (USA)). *J. Nucl. Mater.*; **57**: No. 1, 1-10(Jul 1975).

A method to fabricate high-quality $LiD_{0.5}T_{0.5}$ microspheres having diameters from 40 to 125 μm was developed. These can be provided with a uniform several μm thick coating of nickel, if desired. Techniques were also developed to mount the Li(D,T) microspheres on very thin plastic films to support them for irradiation in the laser beam and to provide them with disk-shaped absorber/ablator layers if desired. (NL)

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 10839, 11438

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

10352 Separation of isotopes by cyclical processes. Hamrin, C.E.; Weaver, K. (to U.S. Energy Research and Development Administration). US Patent Application 557,566. Filed date 11 Mar 1975. 13p.

Various isotopes of hydrogen are separated by a cyclic sorption process in which a gas stream containing the isotopes is periodically passed through a high pressure column containing a palladium sorbent. A portion of the product from the high pressure column is passed through a second column at lower pressure to act as a purge. Before the sorbent in the high pressure column becomes saturated, the sequence is reversed with the stream flowing through the former low-pressure column now at high pressure, and a portion of the product purging the former high pressure column now at low pressure. The sequence is continued in cyclic manner with the product being enriched in a particular isotope. (auth)

10353 Laser isotope separation by multiple photon absorption. Robinson, C.P.; Rockwood, S.D.; Jensen, R.J.; Lyman, J.L.; Aldridge, J.P. III. (to U.S. Energy Research and Development Administration). US Patent Application 570,924. Filed date 22 Apr 1975. 15p.

Multiple photon absorption from an intense beam of infrared laser light may be used to induce selective chemical reactions in molecular species which result in isotope separation or enrichment. The molecular species must have a sufficient density of vibrational states in its vibrational manifold that, in the presence of sufficiently intense infrared laser light tuned to selectively excite only those molecules containing a particular isotope, multiple photon absorption can occur. By this technique, for example, intense CO_2 laser light may be used to highly enrich ^{34}S in natural SF_6 and ^{11}B in natural BCl_3. (auth)

10354 ^{18}O enrichment process in UO_2F_2 utilizing laser light. DePoorter, G.L.; Rofer-DePoorter, C.K. (to U.S. Energy Research and Development Administration). US Patent 3,923,619. 2 Dec 1975. Filed date 16 Sep 1974. 4p.

PAT-APPL-506,479.

Photochemical reaction induced by laser light is employed to separate oxygen isotopes. A solution containing UO_2F_2, HF, H_2O and a large excess of CH_3OH is irradiated with laser light of appropriate wavelength to differentially excite the UO_2^{2+} ions containing ^{18}O atoms and cause a reaction to proceed in accordance with the reaction $2\ UO_2F_2 + CH_3OH + 4\ HF$ yields $2\ UF_4$ down arrow $+ HCOOH + 3\ H_2O$. Irradiation is discontinued when about 10 percent of the UO_2F_2 has reacted, the UF_4 is filtered from the reaction mixture and the residual CH_3OH and HF plus the product HCOOH and H_2O are distilled away from the UO_2F_2 which is thereby enriched in the ^{18}O isotope, or the solution containing the UO_2F_2 may be photochemically processed again to provide further enrichment in the ^{18}O isotope.

10355 Use of plasma instabilities in laser isotope separation. Book, D.L. (Naval Research Laboratory, Washington, D. C. 20375). *J. Appl. Phys.*; **47**: No. 1, 200-203(Jan 1976).

A design is sketched for a continuously operating device which separates one laser-excited isotopic species of a given element from a mixture. The essential innovation is the use of collisionless plasma instabilities to slow down ions of the desired species from two counterstreaming initially neutral beams. (AIP)

RADIATION SOURCES

REFER ALSO TO CITATION(S) 12273

10356 (BNWL—1967) Containment of $^{90}SrF_2$ at 800 to 1100°C preliminary results. Fullam, H.T. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-1830. vp. Dep. NTIS $7.75.

A program is currently underway at PNL to develop the data needed to license $^{90}SrF_2$ for heat source applications. A major portion of the program involves determining the compatibility of $^{90}SrF_2$ with containment materials at elevated temperatures. The compatibility studies are divided into two phases: an initial series of short-term scouting tests lasting up to 4400 h in which a number of containment materials were evaluated, and a subsequent series of long-term tests in which the three best containment materials identified in the short-term tests will be tested for up to 30,000 h with WESF-produced $^{90}SrF_2$. The results of the first phase tests are summarized. The short-term tests were carried-out at temperatures of 800, 1000, and 1100°C for 1500 and 4400 h using both radioactive and nonradioactive strontium fluoride. Nine potential containment materials were evaluated in the tests: two refractory metals (tungsten and TZM); two cobalt base alloys (Haynes Alloy 25 and Haynes Alloy 188); and five nickel base alloys (Hastelloy C-276, Hastelloy X, Hastelloy N, Inconel 600 and Inconel 625). Test results show that both of the refractory metals are very resistant to fluoride attack, and tungsten and TZM specimens exposed to $^{90}SrF_2$ exhibited little or no attack. Haynes Alloy 25 was the best of the Ni- and Co-base alloys, but attack up to a depth of 0.004 in. was observed in some Haynes Alloy 25 specimens exposed to $^{90}SrF_2$. Based on the results of the short-term compatibility tests and several other factors, TZM, Haynes Alloy 25 and Hastelloy C-276, the present WESF capsule material, were selected for long-term testing with $^{90}SrF_2$. (auth)

10357 (SAND—76-0065) Beneficial uses program. Progress report, period ending 31 December 1975. (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1976. Contract AT(29-1)-789. 80p. Dep. NTIS $5.00.

Progress is reported on studies designed to develop the necessary technologies for cost-beneficial uses of existing and future surplus radioactive materials. The purpose of the Waste Resources Utilization Program is to develop a technology to utilize cesium-137, a nuclear power plant by-product, to modify sewage sludge for safe application as a fertilizer or as an animal feed supplement. A major portion of the effort this quarter was directed toward establishment of thermoradiation treatment levels for elimination of pathogenic organisms in sludge. Three groups of pathogenic microorganisms are being studied: viruses, bacteria, and parasites. Other areas of study included physical-chemical properties of thermoradiation treated sewage sludge such as "settling" and "filterability" and pilot plant design for a plant to thermoradiate up to 75 kiloliters of sludge per day. In the Separation Technology and Source Development Program previous work has demonstrated the feasibility of applying the Sandia Solidification Process to the recovery of radiocesium from high-level liquid wastes. The influence of various parameters on ^{137}Cs source intensities was explored. A multiple ceramic ^{137}Cs source package was

found to be essentially the same from a radiation process viewpoint as a single ^{137}Cs source. The tolerable impurity levels in the ceramic sources, in terms of perturbation of the gamma flux, are relatively high (a few percent). (JGB)

DESIGN AND FABRICATION

REFER ALSO TO CITATION(S) 11564

10358 **Neutron source.** Cason, J.L. Jr.; Shaw, C.B. (to U.S. Energy Research and Development Administration). US Patent 3,914,612. 21 Oct 1975. Filed date 26 Aug 1974. 6p.
PAT-APPL-500,790.

A neutron source which is particularly useful for neutron radiography consists of a vessel containing a moderating media of relatively low moderating ratio, a flux trap including a moderating media of relatively high moderating ratio at the center of the vessel, a shell of depleted uranium dioxide surrounding the moderating media of relatively high moderating ratio, a plurality of guide tubes each containing a movable source of neutrons surrounding the flux trap, a neutron shield surrounding one part of each guide tube, and at least one collimator extending from the flux trap to the exterior of the neutron source. The shell of depleted uranium dioxide has a window provided with depleted uranium dioxide shutters for each collimator. Reflectors are provided above and below the flux trap and on the guide tubes away from the flux trap.

10359 **Production of ^{60}Co ceramic fuel forms.** Rankin, D.T.; Smith, P.K.; McBeath, P.E.; Keski, J.R.; McDonell, W.R. (E. I. du Pont de Nemours and Co., Aiken, SC). Contract AT(07-2)-1. *Am. Ceram. Soc. Bull.*; **54**: No. 11, 982-985(Nov 1975).

From Joint Fall meeting of the Basic Science and Nuclear Divisions of the American Ceramic Society; Williamsburg, VA (27 Mar 1975).

The feasibility of producing ^{60}Co ceramic fuel forms of CoO, $Co_{0.5}Mg_{0.5}O$ and $CoAl_2O_4$ was demonstrated. Wafers of each oxide were fabricated to approximately 90 percent of theoretical density by powder ceramic processes. A total of 360 wafers was canned in aluminum and irradiated in control rod positions in a high flux charge to yield activities up to 700 Ci/g Co. Power densities calculated for CoO, $Co_{0.5}Mg_{0.5}O$ and $CoAl_2O_4$ from the average activity of 525 Ci/g were 37, 19, and 11 W(th)/cm³, respectively. Postirradiation inspection showed wafers of each oxide to be intact with no significant change in volume or microstructure. Wafers of ^{60}Co fuel forms could be directly encapsulated into a heat source without reprocessing.

10360 **Tissue irradiator.** Hungate, F.P.; Riemath, W.F.; Bunnell, L.R. (to U.S. Energy Research and Development Administration). US Patent 3,927,325. 16 Dec 1975. Filed date 10 Jul 1974. 8p.
PAT-APPL-487,327.

A tissue irradiator is provided for the in-vivo irradiation of body tissue. The irradiator comprises a radiation source material contained and completely encapsulated within vitreous carbon. An embodiment for use as an in-vivo blood irradiator comprises a cylindrical body having an axial bore therethrough. A radioisotope is contained within a first portion of vitreous carbon cylindrically surrounding the axial bore, and a containment portion of vitreous carbon surrounds the radioisotope containing portion, the two portions of vitreous carbon being integrally formed as a single unit. Connecting means are provided at each end of the cylindrical body to permit connections to blood-carrying vessels and to provide for passage of blood through the bore. In a preferred embodiment, the radioisotope is thulium-170 which is present in the irradiator in the form of thulium oxide. A method of producing the preferred blood irradiator is also provided, whereby nonradioactive thulium-169 is dispersed within a polyfurfuryl alcohol resin which is carbonized and fired to form the integral vitreous carbon body and the device is activated by neutron bombardment of the thulium-169 to produce the beta-emitting thulium-170.

ISOTOPIC POWER SUPPLIES

REFER ALSO TO CITATION(S) 11065

10361 (LA—6013) **Isotope Fuels Impact Tester (IFIT).** Frantz, C.E.; Taylor, J.W.; Court, D.B. (Los Alamos Scientific Lab., N.Mex. (USA)). Jul 1975. Contract W-7405-Eng-36. 22p. Dep. NTIS $4.50.

The Isotope Fuels Impact Tester (IFIT) is used for safely impacting $^{238}PuO_2$ heat sources that have been heated to 2000°C. Impact velocities reach 300 m/s (1000 ft/s). A gas gun with a 178-mm (7-in.) bore is used to accelerate the heat source, which is heated by a furnace built into the projectile. Double containment of the impacted heat source is obtained by two vessels that are sealed directly to the gun muzzle. The impact occurs in the inner vessel, and parts of the projectile jam into and thereby close each vessel. The inner vessel, containing the impacted heat source, is removed from the gun and is placed inside a glovebox for disassembly and heat-source recovery. IFIT's modular structure makes it versatile and adaptable to many types of tests. Many applications have demonstrated its versatility and, more important, its capability for impacting $^{238}PuO_2$ heat sources safely. An approximate theoretical relation is used to predict proper conditions for achieving desired impact velocities. Bore lubricants and projectile-seal design are also important for achieving proper impact velocities. (auth)

10362 (PB—239086) **Development and evaluation of a Stirling cycle energy conversion system. Annual report, May 1973-Jul 1974.** Andrus, S.; Faeser, R.J.; Moise, J.; Hoffman, L.C.; Rudnicki, M.I. (Aerojet Liquid Rocket Co., Sacramento, Calif. (USA)). Aug 1974. Contract PHS-73-2930. 113p. NTIS $5.25.
See also PB—226617.

The Stirling cycle engine is designed to power implantable heart-assist and total-heart-replacement systems. Heat is provided by a ^{238}Pu radioisotope capsule. Program activity during the report period included development and in vivo testing of the Heart Assist System including the PAC-4 actuator and the MK V engine; design of an advanced actuator, PAC-5; and design, fabrication and testing of the THA-1 Total Heart actuator. (GRA)

DESIGN AND FABRICATION

10363 (BNWL—1845-18) **Pacific Northwest Laboratory monthly report to Advanced Nuclear Energy Systems, Space and Special Purposes Division for November 1975.** Fullman, H.T. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1975. Contract E(45-1)-1830. 8p. Dep. NTIS $4.50.

At Hanford, strontium will be separated from the high-level waste, then converted to the fluoride, and doubly encapsulated in small, high-integrity containers for subsequent long-term storage. The fluoride conversion, encapsulation and storage will take place in the Waste Encapsulation and Storage Facilities (WESF). This encapsulated strontium fluoride represents an economical source of ^{90}Sr if the WESF capsule can be licensed for heat source applications under anticipated use conditions. The objectives of this program are to obtain the data needed to license $^{90}SrF_2$ heat sources and specifically the WESF $^{90}SrF_2$ capsules. The information needed for licensing can be divided into three general areas: long-term SrF_2 compatibility data; chemical and physical property data on $^{90}SrF_2$; and capsule property data such as external corrosion resistance, crush strength, etc. The current program is designed to provide the required information. (auth)

10364 (DPST—74-128-1) **Savannah River Laboratory monthly report: ^{238}Pu fuel form processes.** (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Jan 1974. Contract AT(07-2)-1. 22p. Dep. NTIS $3.50.

SNS has advised that plans for production in the PuFF Facility include a production requirement of 15 kg as PPO for the last half of FY-76. The thermal conductivity of reverse-strike $^{238}PuO_2$ powder was measured in air and argon. Bed thicknesses for $^{238}PuO_2$ powder arrays were calculated and specified to control process temperatures. The schedule of the full-scale experimental facilities has been revised. Initial operations with ^{238}Pu is forecast for March 1975, with hot pressing to begin in May 1975 or later, depending on the date of availability of FY-1975 capital funds. (auth)

10365 (DPST—74-128-2) **Savannah River Laboratory monthly report: ^{238}Pu fuel form processes.** (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Feb 1974. Contract AT(07-2)-1. 42p. Dep. NTIS $4.00.

SNS has requested a review of specifications for $^{238}PuO_2$ feed. A full-scale demonstration with an optimized ball mill produced t[illegible] required particle size distribution in 2 h compared to 32 h for previous designs. Six pellets have been hot-pressed to show reproducibility of hot-press conditions. Lower densities than expected were obtained for pellets fabricated according to the recommended parameters. 440 g of direct-strike $^{238}PuO_2$ were produced for the Milliwatt RTG program; the oxide contains considerably more fines than expected. (auth)

10366 (DPST—74-128-3) **Savannah River Laboratory monthly report: ^{238}Pu fuel form processes.** (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Mar 1974. Contract AT(07-2)-1. 53p. Dep. NTIS $4.50.

Specifications proposed by SRP for $^{238}PuO_2$ feed are presented in response to an SNS proposal for tighter specifications. Calculations show that radiolysis of volatiles in $^{238}PuO_2$ storage and shipping containers will not result in excessive pressure within the vessel nor potential damage from hydrogen reaction. The design of the $^{16}O_2$ exchange furnace can employ $^{16}O_2$ flowing over beds of $^{238}PuO_2$, rather than through the powder, without significant loss of efficiency or time. BET surface area analysis of $^{238}PuO_2$ powders yields only approximate values because of self-heating of the powder. PPO and PMC shards were not damaged from released helium after 2 months aging. Post-hot-pressing heat treatment of PPO pellets has begun to optimize and shorten the time required to remove carbon, complete sintering, and restore stoichiometry. A surface-barrier detector is being adapted to measure residual alpha activity on PISA's after decontamination in the PuFF Facility. Because of high fines content in a recent production of direct-strike $^{238}PuO_2$ an older lot was shipped to MRC for the Milliwatt RTG. This lot subsequently was shown also to have a large amount of fines caused by long-term aging. Both direct-strike and reverse-strike oxide were found to exhibit this degradation. The contaminated glove box and obsolete metallograph in the Alpha Materials Facility have been removed and the replacement glove box with the new metallograph mounted in place. (auth)

10367 (DPST—74-128-4) **Savannah River Laboratory monthly report: ^{238}Pu fuel form processes.** (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Apr 1974. Contract AT(07-2)-1. 32p. Dep. NTIS $4.00.

In direct-strike $^{238}PuO_2$, agglomeration occurs in the oxalate precipitate and is unaffected by washing agent or calcining temperature. The evaluation of an automatic pulverizer-classifier for the PuFF Facility was begun. Difference between the mini-hot press at SRL and the LASL full-scale hot press require higher pressures to be used at SRL to obtain the density specified for PPO. Hot-pressed density was found to vary with applied pressure and, to a lesser extent, with size of feed. The new contained metallograph has been installed. A wire saw has been placed in containment for precise cutting of PPO pellets. The scanning microscope was mounted within the glove boxes. (auth)

10368 (DPST—75-128-11) **Savannah River Laboratory monthly report: ^{238}Pu fuel form processes.** (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Nov 1975. Contract AT(07-2)-1. 47p. Dep. NTIS $4.00.

The equation relating the mode size of calcined $^{238}PuO_2$ powder to precipitation variables has been revised with the addition of more data and is now applicable over a broader range of precipitation conditions. Characterization of samples received from Los Alamos Scientific Laboratory (LASL) indicates that oxygen exchange and outgassing have little effect on particle size and tap density, and show that the powder is incompletely milled after 32 hours of ball milling. A correlation between the mass median particle size of milled powder and final pellet density indicates that variations in milled particle sizes may be directly responsible for the variations in fabricability. Thermal gradients due to self-heat of $^{238}PuO_2$ have been calculated for oxalate calcination operations in H-Area B-Line and for feed preparation operations in the Plutonium Fuel Form Facility (PuFF). Gradients of less than 50°C are expected in each of the feed preparation steps; however, smaller loads or redesigned crucibles will be necessary to reduce the thermal gradient to less than 200°C during calcinations. The helium release from $^{238}PuO_2$ pellets of 90 percent theoretical density that were heated after 18 months storage caused pronounced grain boundary separation. Design of the Plutonium Experimental Facility is 95 percent complete, and construction is 31 percent complete. (auth)

10369 (DPST—75-128-12) **Savannah River Laboratory monthly report: ^{238} Pu fuel form processes.** (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Dec 1975. Contract AT(07-2)-1. 30p. Dep. NTIS $4.00.

An equation relating precipitation parameters with agglomeration has been established which can predict the agglomeration index to +-5 wt percent. The solubility of Pu(III) oxalate was measured as a function of temperature, nitric acid concentration, and oxalic acid concentration. The decontamination factors (DF's) for individual impurities during precipitation are being determined. Preliminary data show a DF of two for aluminum and iron. The concentration of calcium increased tenfold. The concentrations of other cations did not change (except possibly for lead). Dependence of grain boundary helium bubble formation on the grain size and concurrently varying porosity of $^{238}PuO_2$ shards was further defined. Critical grain sizes, above which gas bubbles were formed, decreased with increasing temperature. (auth)

10370 (IFA-FR—138-1975) **Use of a converted magnetron for making electric generators with radioisotopes or a converting cell of the fission nuclear energy.** Cristea, G.; Fratiloiu, G. (Institutul de Fizica Atomica, Bucharest (Romania)). Jun 1975. 15p. Dep. NTIS (US Sales Only) $3.50.

In this paper the working principle of a magnetron is examined from the standpoint of the accomplishing of the necessary transformation of this device. The principle of the electric generator with radioisotopes as well as of the converting cell of the fission nuclear energy using a modified magnetron is explained. Both the electric generator with radioisotopes and the converting cell of the fission nuclear energy represent energy sources supplied in the form of micro-waves—the main power source -and of direct current—the secondary reduced power source. (auth)

10371 (MLM—2203) **Warm hydroforming of iridium + 0.3 wt % tungsten hemishells.** Wyder, W.C. (Mound Lab., Miamisburg, Ohio (USA)). 5 Mar 1976. Contract E-33-1-GEN-53. 14p. Dep. NTIS $4.00.

A technique for the production of iridium alloy hemispherical shells to be used for the primary encapsulation of plutonium-238 oxide spheres is described. The encapsulated spheres, 24 per heat source, provide the thermal heat used to drive thermoelectric converters which supply power for the Department of Defense's LES 8/9 satellites. The technique used a standard production type Hydroform machine converted for hot tooling. The iridium alloy discs were canned in stainless steel waster sheets of a larger size than the iridium discs and separated from the latter by tantalum foil barrier discs. The stainless steel was electron beam welded around the edge to form an envelope. The iridium disc assembly was heated to approximately 900°C and the tooling to approximately 500°C. After forming, the iridium shell was cut to length while in the waster sheet; and the latter was removed by dissolving in hot aqua regia. After removal of the waster sheets, the hemishells were cleaned and heat treated. Production efficiency reached a level of better than 95 percent and was maintained to produce some 600-odd hemishells.

10372 (PB—239447) **Vapor cycle energy system for implantable circulatory assist devices. Annual report, Jul 1973-Jul 1974.** Hagen, K.G. (Thermo Electron Corp., Waltham, Mass. (USA)). Aug 1974. Contract N01-HV-4-2909. 160p. (TE—4182-29-75). NTIS $6.25.

See also PB—237621.

The report describes the development status of a heart assist system driven by a nuclear fueled, electronically controlled vapor cycle engine termed the tidal regenerator engine (TRE). The TRE pressurization (typically from 5-160 psia) is controlled by a torque motor coupled to a displacer. The electrical power for the sensor, electronic logic and actuator is provided by a thermoelectric module interposed between the engine superheater and boiler. The TRE is directly coupled to an assist blood pump which also acts as a blood-cooled heat exchanger, pressure-volume transformer and sensor for the electronic logic. Engine efficiencies in excess of 10 percent have been demonstrated. A binary version of the engine with twice the potential efficiency is being investigated. Efficiency values as high as 13 percent have been achieved to date. (GRA)

USES

10373 (AD/A—008191) **Operating report for radioisotopic power generators of the U.S. Navy. Volume 8, number 1. Report for 1 Jan-30 Sep 1974.** (Naval Nuclear Power Unit, Fort Belvoir, Va. (USA)). 30 Sep 1974. 79p. NTIS $4.75.

See also report dated 31 Dec 1973, AD—781261.

The objective of this operating report is to serve as a vehicle for the accumulation and dissemination of information concerning the application and operation of radioisotopic power generators (RPGs) within the Navy. It will be noted that all RPGs presently listed are radioisotope thermoelectric generators (RTGs). Unless specifically identified as an engineering evaluation, items contained in this report are presented as an impartial collection of facts, observations and other information. (GRA)

HYDROGEN

REFER ALSO TO CITATION(S) 10846

10374 (UCRL—76850) **Hydrogen economy: its potential promises and problems.** Sauter, G.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Dec 1975. Contract W-7405-Eng-48. 10p. (CONF-760304—2). Dep. NTIS $3.50.

From 1. world hydrogen energy conference; Miami Beach, Florida, United States of America "USA" (1 Mar 1976).

In recent years a number of new energy technologies have been proposed for development on a large, commercial scale. Among these are solar power, nuclear fission, nuclear fusion, geothermal power, and wind power. Hydrogen energy also has its proponents. It differs from the others mentioned inasmuch as the others represent primary sources of energy, while hydrogen represents a means for facilitating the transmission, storage, and utilization of energy which potentially can be coupled to a variety of primary sources. It is not clear what role, if any, these various technologies will play in the emerging energy scene. It is clear that no single technology will be "the" answer to the growing energy problem. For the foreseeable future, proponents of the hydrogen energy concept will be in competition for limited energy research and development funds with proponents of other energy technologies. To be successful in obtaining support, it will be necessary for them to carefully and completely develop and publicize a valid, rational, and even compelling case for the hydrogen energy concept, a case that clearly delineates not only those areas where hydrogen appears to have an advantage over competing technologies but also those for which hydrogen may not be the best answer. (auth)

PRODUCTION

10375 (TID—3358) **Hydrogen fuels: a bibliography.** (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Feb 1976. 484p. Dep. NTIS $12.50.

The bibliography comprises 4544 citations on the production, storage, transport, marketing and economics, safety, industrial and commercial use, and properties of hydrogen. (LK)

10376 **Method and apparatus for producing synthetic fuels from solid waste.** Antal, M.J. Jr. (to U.S. Energy Research and Development Administration). US Patent Application 563,274. Filed date 28 Mar 1975. 12p.

Organic solid wastes represented by the general chemical formula C/sub X/H/sub Y/O/sub Z/ are reacted with steam at elevated temperatures to produce H_2 and CO_2. The reaction for the overall process is endothermic and requires heat. This heat is supplied by a tower top solar furnace; alternatively, some of the solid wastes can be burned to supply heat for the reaction. The hydrogen produced by this reaction can be used as a fuel or a chemical feedstock. Since the reaction is endothermic, the system represents a method for storing heat energy from an external source in a chemical fuel produced from solid wastes.

ELECTROLYSIS

10377 (BNL—20877) **Prospects for hydrogen production by water electrolysis to be competitive with conventional methods.** Srinivasan, S.; Salzano, F.J. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. 16p. (CONF-760304—10). Dep. NTIS $3.50.

From 1. world hydrogen energy conference; Miami Beach, Florida, United States of America *USA* (1 Mar 1976).

With the impending unavailability of oil and natural gas, hydrogen will be produced on a large scale in the United States (1) from coal, or (2) by water electrolysis using electricity derived from nuclear or solar energy. In many parts of the world which lack fossil fuels, the latter will be the only possible method. The cost of purification of hydrogen produced from fossil fuels will increase its cost to about the same level as that of electrolytic hydrogen. When hydrogen is required in relatively small quantities too, the electrolytic method is advantageous. To minimize the cost of hydrogen produced by water electrolysis, it is necessary to reduce capital costs and approach 100 percent energy efficiencies. Areas of research, which will be necessary to achieve these goals are: (1) maximization of surface areas of electrodes; (2) use of thin electrolyte layers; (3) increase of operating temperature in alkaline water electrolysis cells to about 120-150°C; (4) selection and evaluation of separator materials; (5) electrocatalysis of the hydrogen and oxygen electrode reaction; (6) mixed oxides as oxygen electrodes; and (7) photoelectrochemical effects. The progress made to date and proposed studies on these topics are briefly dealt with in this paper. The General Electric Solid Polymer Water Electrolyzer and Teledyne Alkaline Water Electrolysis Cells, both operating at about 120-150°C, look mostpromising in achieving the goals of low capital cost and high energy efficiency. (auth)

10378 (BNL—20878) **Water electrolysis vs. thermochemical production of hydrogen: a parametric assessment.** Salzano, F.J.; Braun, C. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. 22p. (CONF-760304—7). Dep. NTIS $3.50.

From 1. world hydrogen energy conference; Miami Beach, Florida, United States of America *USA* (1 Mar 1976).

A general discussion of hydrogen production by electrolytic and thermochemical processes is presented. A hydrogen production cost computation and cost sensitivity data for the various production methods are reported. (LK)

10379 (UCRL—76844) **Will the large-scale production of hydrogen be part of the energy problem or part of its solution.** Sauter, G.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Dec 1975. Contract W-7405-Eng-48. 18p. (CONF-760304—11). Dep. NTIS $3.50.

From 1. world hydrogen energy conference; Miami Beach, Florida, United States of America *USA* (1 Mar 1976).

The energy dynamics of nuclear reactors as a means of generating hydrogen is analyzed. Attention is focused on the following two questions, over a range of values for the rate of expansion of the reactor network and the ratio of the energy required to build a reactor to the energy it produces: (1) What would be the energy cost of developing a given system; will it produce more energy than it costs, or will it be a net drain on our already troubled energy economy. (2) Given that the system will produce net energy, will the energy be produced in adequate amounts and in a timely fashion. Based on the results of this analysis, a specific scenario was examined - the development by the year 2000 of the capacity to generate annually the amount of hydrogen which has the heat content of the natural consumed in the U.S. in 1970. For this scenario, it appears that the reactors, rather than the hydrogen, will be the energy storage mechanism. (LK)

THERMOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 10378

10380 (CONF-760401—1) **Thermochemical decomposition of water based on reactions of chromium and strontium compounds.** Bamberger, C.E.; Richardson, D.M. (Oak Ridge National Lab., Tenn. (USA)). 1976. 7p. Dep. NTIS $3.50.

From ACS national meeting on thermochemical generation of H2; New York, New York, United States of America *USA* (4 Apr 1976).

The chemistry of ternary oxides of chromium makes possible a closed cycle consisting of three reactions. A cycle of the strontium chromates (IV), (V), and (VI) is reported that affords lower temperatures and easier separations than those in an earlier barium cycle. (LK)

10381 (ORNL—5111, pp 119-120) **Thermal generation of hydrogen.** Feb 1976.

In Chemistry Division annual progress report for period ending November 1, 1975.

The experimental search for closed cycles for the thermal generation of hydrogen from water was continued based on previously established criteria. The feasibility of the following cycles was established: Fe(II)/MOH; Cr(III)/MOH; and, Cr(III)/$Ba(OH)_2$. (JGB)

10382 **Method of hydrogen production.** Gomberg, H.J. (to Texas Gas Transmission Corp., Owensboro, Ky. (USA)). German(FRG) Patent 2445953/A/. 22 May 1975. 13p. (In German).

2 figs.

The method to produce hydrogen involves a combination of chemical and radiolytical process steps where the hydrogen is to be used as fuel or component of a hydrogen based fuel. Despite the many steps, the process completely recycles all chemical materials except the originally added materials. The production of hydrogen and oxygen from water and a halogen, e.g., calcium bromide as recycleable molecule, is an example. The water and halogen are mixed and are converted at a high temperature, e.g., 730°C, by the addition of heat into hydrogen halide and oxygen. The hydrogen halide is then subjected to radiation from a nuclear fusion, e.g., deuterium—tritium fusion, and decomposed into hydrogen and the halogen. A nuclear fusion reaction may also be used to produce the heat in the chemical reaction. A further cycle is possible with a mixture of water and chlorine gas. (DE)

10383 **Thermochemical production of hydrogen.** Grimes, W.R.; Bamberger, C.E. (to U.S. Energy Research and Development Administration). US Patent 3,919,406. 11 Nov 1975. Filed date 10 Jul 1974. 6p.

PAT-APPL-487,323.

Hydrogen is produced by reacting cuprous chloride with hydrochloric acid. The reaction may be combined to form a thermochemical closed process for producing hydrogen by a series of four reactions utilizing chlorides of copper and magnesium, hydrochloric acid, and magnesium oxide to break water down into its constituent elements. 4 claims, 1 drawing figure.

10384 Chemical cycle for thermochemical production of hydrogen from water. Bamberger, C.E.; Richardson, D.M. (to U.S. Energy Research and Development Administration). US Patent 3,927,192. 16 Dec 1975. Filed date 29 Jan 1975. 6p.
PAT-APPL-545,042.

Hydrogen is produced by a closed cyclic process involving the reaction of chromic oxide with an alkali metal hydroxide to produce hydrogen, water and an alkali metal hypochromate as reaction products. The hypochromate is converted to the chromate by reaction with water to also produce the beginning chromic oxide and alkali metal hydroxide. The cycle is completed by reacting the thus formed chromate with the excess alkali metal hydroxide at a higher temperature to produce hypochromate water and oxygen. 4 claims, 1 drawing figure.

10385 Thermochemical production of hydrogen. Krikorian, O.H. (to U.S. Energy Research and Development Administration). US Patent 3,928,549. 23 Dec 1975. Filed date 20 Jun 1974. 6p.
PAT-APPL-481,263.

A closed cycle reaction sequence is described for the thermochemical production of hydrogen utilizing, as an intermediate, a metalloidal element from Group V or Group VI of the periodic system, specifically, an element from the arsenic-antimony-bismuth subgroup of Group V or the selenium-tellurim subgroup of Group VI, and the compounds thereof. The closed cycle process comprises the steps of: (1) hydrolyzing an intermetallic compound of a metal, preferably an alkali or alkaline earth metal, and a metalloidal element of the type described, thereby producing an oxide or hydroxide of the metal, hydrogen, and the metalloidal element, or a compound which readily yields hydrogen and the metalloidal element; (2) reacting the metalloidal element with the metal oxide or hydroxide, thereby regenerating the intermetallic compound and producing a marginally stable oxide of the metalloidal element; (3) reducing the oxide of the metalloidal element with a reducing agent which can be regenerated by thermal decomposition, thereby regenerating the metalloidal element and oxidizing the reducing agent; and (4) decomposing the oxidized reducing agent, thereby regenerating the reducing agent and producing oxygen. The net reaction of the foregoing sequence is the decomposition of water into hydrogen and oxygen. 11 claims, no drawings.

10386 Process for generating hydrogen. Bamberger, C.E.; Richardson, D.M.; Grimes, W.R. (to U.S. Energy Research and Development Administration). US Patent 3,929,979. 30 Dec 1975. Filed date 10 Sep 1974. 6p.
PAT-APPL-504,790.

Magnetic iron oxide is reacted with an alkali metal hydroxide to produce hydrogen as a product. Alkali metal ferrite is also produced as a product and is subjected to reaction with water to produce ferric oxide and the alkali metal hydroxide used in the first reaction. The ferric oxide is decomposed by heat such that magnetic iron oxide and oxygen are products of the decomposition. By carrying out the reactions in the appropriate order, a closed thermochemical process for splitting water into hydrogen and oxygen is provided. 6 claims, 1 drawing figure.

10387 Method of producing hydrogen. Abraham, B.M.; Schreiner, F. (to U.S. Energy Research and Development Administration). US Patent 3,929,980. 30 Dec 1975. Filed date 26 Dec 1974. 4p.
PAT-APPL-536,694.

Water is thermochemically decomposed to produce hydrogen by the following sequence of reactions. KNO_3 and I_2 are reacted to produce KI, NO and O_2, the NO and O_2 thus produced are reacted with water to form HNO_3, a hydrogen-containing iodide—NH_4I or HI—is formed from the HNO_3, and this iodide is thermally decomposed to produce hydrogen, all products of the reactions being recycled except hydrogen and oxygen. 2 claims, no drawings.

BIOSYNTHESIS

10388 Photoproduction of molecular hydrogen by a plant-algal symbiotic system. Newton, J.W. (Dept. of Agriculture, Peoria, IL). *Science;* **191**: No. 4227, 559-561(13 Feb 1976).

The rapidly growing water fern Azolla, which contains a nitrogen-fixing blue-green algal symbiont, has been studied as a possible system for photoproduction of molecular hydrogen. When this plant is grown on a combined nitrogen supply, photochemically generated hydrogen can be diverted through the algal nitrogenase system, which serves as a source of molecular hydrogen generated from water. This symbiosis has several advantages as a possible biological energy conversion system. (auth)

STORAGE

REFER ALSO TO CITATION(S) 10375, 10392

CHEMISORPTION

10389 Iron titanium manganase alloy hydrogen storage. Reilly, J.J.; Wiswall, R.H. Jr. (to U.S. Energy Research and Development Administration). US Patent 3,922,872. 2 Dec 1975. Filed date 4 Feb 1975. 2p.
PAT-APPL-547,073.

A three component alloy capable of reversible sorption of hydrogen having the chemical formula $TiFe_1$/sub minus x/ Mn/sub x/, where x is in the range of about 0.02 to 0.5, and the method of storing hydrogen using this alloy are reported. 4 claims, 2 drawing figures.

TRANSPORT

REFER ALSO TO CITATION(S) 10392

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 10378

INDUSTRIAL AND COMMERCIAL USE

REFER ALSO TO CITATION(S) 10669

10390 (BNL—20899) **Closed Brayton cycle using hydrogen as a work fluid.** Powell, J.R.; Salzano, F.J.; Yu, W.S.; Milau, J. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. 13p. (CONF-760304—9). Dep. NTIS $3.50.

From 1. world hydrogen energy conference; Miami Beach, Florida, United States of America "USA" (1 Mar 1976).

A high efficiency power cycle is proposed which uses H_2 gas as a working fluid in a regenerative closed Brayton cycle. The H_2 gas is compressed by an absorption/desorption cycle on metal hydride ($FeTiH$/sub x/) beds. Low temperature solar or geothermal heat ($T \sim 100^{\circ}C$) is used for the compression process, and high temperature fossil or nuclear heat ($T \sim 700^{\circ}C$) supplies the expansion work in the turbine. Typically, ~ 90 percent of the high temperature heat input is converted to electricity, while ~ 3 kW of low temperature heat is required per kW of electrical output. (auth)

10391 Hydrogen engine performance. Finegold, J.; Van Vorst, W. (Univ. of California, Los Angeles). pp 15-20 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

The performance of a 1973 Chevrolet, 350 cubic inch displacement V-8 engine modified for hydrogen-fueled operation is compared with its standard operation with gasoline. Efficiencies for hydrogen of from 25 to 100 percent greater than those obtained with gasoline are reported. The higher values are at lower power output. Exhaust emissions with hydrogen were essentially free of carbon monoxide and unburned hydrocarbons and dramatically reduced in oxides of nitrogen. The problem of "backfire" with hydrogen is discussed. (auth)

PROPERTIES

REFER ALSO TO CITATION(S) 11216

10392 (SAND—75-0426, pp 8-14) **Development of materials for hydrogen storage and transport.** Brooks, J.A.; West, A.J. Feb 1976.

In Sandia technology, Autumn 1975.

Thermomechanical processing or slight modification of chemical composition can improve the ability of steels to resist failure in hydrogen environments. (auth)

OTHER SYNTHETIC AND NATURAL FUELS

REFER ALSO TO CITATION(S) 10846, 10848, 10849

HYDROCARBON FUELS

REFER ALSO TO CITATION(S) 10234, 10241, 10243, 10268

10393 (PB—238563) **Fuel gas production from solid waste. Supplemental report, 1 July 1973—30 June 1974.** Cooney, C.L.; Lindsey, E.E.; Kirk, R.S.; Oyewole, S. (Dynatech R/D Co., Cambridge, Mass. (USA)). 31 Jul 1974. Contract NSF-C827. 77p. (DYNATECH—1213). NTIS $4.75.

See also report dated 31 Jul 1974, PB—238068.

This report contains two final reports from Dynatech subcontractors. Part 1 consists of the report of the MIT program, Fuel Gas Production from Solid Waste by Thermophilic Anaerobic Digestion. The advantages of thermophilic digestion over the traditional mesophilic digestion are discussed. The primary drawback to thermophilic digestion is the need to supply heat to maintain the temperature above 50 degrees C. It is concluded that anaerobic thermophilic digestion of cellulose waste is a feasible operation for the production of fuel gas. The effects of residence time, recycle, and temperature on the extent of solid waste degradation, biological mass formed, and quantity and quality of gas produced are discussed. Recommendations for future research are presented. Part 2 is entitled Fuel Gas from Solid Waste and is the final report from the Univ. of Massachusetts. It contains three sections: Kinetic Studies on Anaerobic Digestion of Solid Waste; Feasibility of an On-Line Instrument for Measuring Anaerobic Digestion Microbial Activity; and Development of Process Techniques for Microorganisms Separation. Details of digester operation are included. (GRA)

10394 (AD/A—006007) **Application of deuterized compounds for the study of kinetics and mechanism of the thermal conversions of hydrocarbons.** Yampolskii, Yu.P.; Maximov, Yu.V. 26 Nov 1974. Working copy machine translation of mono. Gorenie i Vzryv, Moscow, 1972, p650-653, by Robert D. Hill. (FTD-MT—24-2004-74). 22p. NTIS $3.25.

The method of labeled molecules using deuterized hydrocarbons, widely used for the study of catalytic processes, in a number of cases can be successfully applied for the explanation of the reaction mechanism of the thermal decomposition of hydrocarbons. This work gives results of a study of kinetics and mechanism of the thermal transformations of acetylene with the pyrolysis of ethylene and cracking of ethane with the aid of additions of deuterized bonds. (GRA)

10395 Energy recovery systems for municipal solid waste: a technical/economic review and forecast. Franklin, W.E.; Bendersky, D.; Park, W.R. (Midwest Research Inst., Kansas City, Mo). pp 129-135 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

A technical and economic review is given of various systems for recovery of energy from solid wastes. The three categories of systems discussed are heat recovery incinerators, refuse fuel systems, and pyrolysis systems. Two other systems that do not fall into these categories, the CPU-400 system for power generation and the Black Clawson Company system for wet processing of municipal solid waste for power production, are also examined. (JSR)

10396 LANDGARD for solid waste disposal: Baltimore progress report. Buss, T.F. pp 136-140 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

The Landgard system for pyrolysis of shredded solid waste for the production of steam, electricity, or gaseous fuel with materials recovery is briefly described. The construction progress on the Baltimore plant is reported. Operational experience from prototype installations in Japan is described. (JSR)

10397 Energy recovery from mixed municipal refuse: the PUROX system. Marple, D.D. (Union Carbide Corp., Chicago). pp 146-152 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

The Purox system for the pyrolysis of shredded or unshredded municipal wastes in the presence of pure oxygen for the production of a medium Btu fuel gas is briefly described. The net energy output of the system is reviewed. (JSR)

10398 Production of charcoal from sawdust in a fluidized bed. Grimmett, E.S. (to U.S. Energy Research and Development Administration). US Patent 3,929,585. 30 Dec 1975. Filed date 16 Aug 1972. 6p.

PAT-APPL-281,255.

A method is reported for disposing of wood refuse and recovering valuable wood by-products without polluting the environment by mixing the wood refuse with inert granulated bed material to form a fluidizable mixture which is heated in a fluidized bed pyrolyzer until charcoal and other by-products are formed. Upon discharge of the charcoal and bed material, the inert material is mixed with additional wood refuse and recirculated. The other wood by-products are carried from the pyrolyzer with the off-gas, from which they are separated and recovered for further processing. The method is also useful for producing activated charcoal by treating the charcoal and bed material mixture in a second fluidized bed to activate the charcoal. Also disclosed is a fluidized bed containment vessel having a baffled interstructure to eliminate back mixing of the wood refuse with the charcoal already formed in the bed. 4 claims, 2 drawing figures.

10399 Velocity of sound and heat capacity in methane from near-critical to subcritical conditions and equation-of-state implications. Gammon, B.E.; Douslin, D.R. (Bartlesville Energy Research Center, OK). *J. Chem. Phys.*; **64**: No. 1, 203-218(1 Jan 1976).

Values of the velocity of sound and derived values of the constant volume heat capacity in methane were determined as functions of temperature and pressure along the phase boundaries, at 298.15°K, and at densities from 0-11.6 mol dm^{-3} for temperatures from 113.5-193.05°K. Relative values of the density were also determined. Velocity dispersion arising from vibrational relaxation, relaxation near the critical point, and relaxation near the triple point were characterized. Results were tested by use of extended thermodynamic scaling representations for the chemical potential μ. Within the limits of possible computational errors, the results indicate that along the critical isochore, (delta$^2\mu$/deltaT^2)/sub p/ is finite, nonzero, and has a jump discontinuity at the critical temperature which implies that $\epsilon = 2$, $(\beta + \alpha) = (1/2)$, and $\alpha \approx (1/7)$, where α, β, and ϵ are scaling exponents. 56 references, 5 tables, 10 figs. (auth)

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 10395, 10890

10400 Material recovery from solid waste at Franklin, Ohio. Blakley, E.T. pp 136-137 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

The Black Clawson system for the wet processing of municipal wastes for the recovery of ferrous metals, glass, and paper products and for energy recovery by incineration of residual organic material with 50 percent moisture is described. The plant at Franklin is the most complete automatic materials recovery plant in the world. (JSR)

10401 Refuse as a supplementary fuel. Hinchman, H.B. (Horner and Shifrin, Inc., St. Louis). pp 153-156 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

Experience gained in the use of processed municipal wastes as a supplementary boiler fuel in St. Louis is described. The necessity of interrelationships between Federal and local governments and private utilities is emphasized. The premises and parameters on which the experiment was based are outlined, and the current state of development is reviewed. The attitudes of utilities, public officials, and the general public and their effect on the implementation of similar systems are discussed briefly. (JSR)

10402 Combustion of municipal solid waste. Govan, F.A.; Martin, D.; Monro, R.J. (York Research Corp., Stamford, CT). pp 157-160 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

The arguments against the use of municipal solid wastes are reviewed and shown to be inapplicable if treated wastes are used. The areas considered are storage and transportation, deposition and fouling, corrosion, and pollution control. (JSR)

SOLAR ENERGY

REFER ALSO TO CITATION(S) 10760, 10846, 10883

RESOURCES AND AVAILABILITY

HEAT STORAGE AND REJECTION

10403 (AD/A—007484) **Spectral analysis of the energy exchange at OWS NOVEMBER.** Rabe, K.M. (Naval Postgraduate School, Monterey, Calif. (USA)). Mar 1975. 105p. NTIS $5.25.

Thesis.

Oceanographic and meteorological data from Ocean Weather Station (OWS) NOVEMBER were analyzed by statistical and spectral methods in order to describe the nature and periodicities of the air-ocean energy exchange. Salinity data from 1968 through 1970 were compared with daily observed parameters commonly associated with changes in the salinity. Regression analysis showed surface salinity to be highly correlated with surface pressure which is interpreted as the surface salinity responding to a baroclinic transport. Twenty-four years (1947-1970) of daily averaged, observed climatological values, as well as heat exchange terms computed from them, were compared with the sea-surface temperature time series and spectrally analyzed. The spectral analysis yielded spectral density, phase and coherence functions indicating the response of surface temperature to the heat exchange terms. (GRA)

SITE GEOLOGY AND METEOROLOGY

REFER ALSO TO CITATION(S) 11471

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 10839, 11438

SOLAR ENERGY CONVERSION

REFER ALSO TO CITATION(S) 10390

PHOTOVOLTAIC CONVERSION

10404 (BMFT-FB-W—75-14) **Development of large-area thin silicon solar cells.** Fischer, H.; Pschunder, W. (Bundesministerium fuer Forschung und Technologie, Bonn (F.R. Germany); Zentralstelle fuer Luft- und Raumfahrtdokumentation und -information, Muenchen (F.R. Germany)). Sep 1975. 121p. (In German). INIS.

65 figs.; 2 tabs.; 15 refs. Available from ZLDI.

The investigations deal with the development of economic processes for fabricating large area, thin silicon solar cells. The influence of various methods on the electrical and mechanical properties has been thoroughly investigated. For specific applications, such as flexible solar generators, new contact geometries are innovated. A simple solution is presented for the fabrication of a p^+-backside contact. Electrical data and environmental test data of large area cells per unit area are comparable to those of standard cells. For the present state-of-the-art 2 x 4 cm cells with aproximately 200 μm thickness seem to be the most economical ones. (DE)

10405 (COO—2593-1) **Solar silicon definition. Progress report, 15 October 1974—15 September 1975.** Wakefield, G.F.; Brown, G.A.; Chu, T.L.; Harrap, V. (Texas Instruments, Inc., Dallas (USA)). Sep 1975. 61p. (NSF/RANN/SE/AER—75-03972/FR/75/1). Dep. NTIS $4.50.

This project was conducted to determine the optimum silicon quality for cost-effective solar cells suitable for large-scale terrestrial utilization. The effects of selected impurities upon the solar cell performance were investigated by preparation and characterization of a matrix of silicon samples. Evaluation of the I-V curves to obtain the slope of the forward current of simple p-n junctions provided rapid material evaluation. Experimental techniques were demonstrated for achieving reliable data from diodes and solar cells. The primary electrical parameters measured were I-V characteristics. (auth)

10406 (CRN-CNPA—75-12) **Silicon solar cells made by ion implantation and glow discharge.** Ponpon, J.P.; Siffert, P. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires). 1975. 30p. INIS.

From 11. IEEE Photovoltaic specialists conference; Phoenix, Arizona, USA (6 May 1975).

Three different methods of silicon solar cell preparation are considered and investigated: low energy implantation, and glow discharge and prebombarded Schottky barriers. The properties of the contact layers realized by these processes are compared in terms of junction depth and sheet resistance. Preliminary results show the usefulness of these techniques for terrestrial solar cell realization. (FR)

10407 (ERDA/JPL—95355-75/1) **Large area silicon sheet by EFG. First quarterly progress report.** Morrison, A.D. (Mobil Tyco Solar Energy Corp., Waltham, Mass. (USA)). 11 Dec 1975. 23p. Dep. NTIS $3.50.

For Jet Propulsion Lab., Pasadena, CA.

Five ribbon growth efforts have been made under the program; the results have not yet been characterized. Furnace modification is on schedule. An initial metallographic evaluation of Si:C interaction has been made and seeds for orientation experiments have been prepared. (auth)

10408 (ERDA/JPL—954334-75/1) **Process for high volume low cost production of silane silicon material task of the low cost silicon solar array project. Quarterly report No. 1, October 6, 1975—December 18, 1975.** Breneman, W.C. (Union Carbide Corp., Sistersville, W.Va. (USA)). 20 Jan 1976. Contract NAS7-100. 23p. Dep. NTIS $3.50.

The objective of this research program is to demonstrate the feasibility for the high volume low cost production of silane (SiH_4), as an intermediate for solar or semi-conductor grade silicon. The goal of the program is to demonstrate the feasibility for achieving a net production cost of less than $5.00 per kilogram of silane through the operation of a 10 pound/day scale pilot plant. The process to be investigated is based on the catalytic disproportionation of chlorosilanes using a tertiary amine ion exchange resin followed by fractional distillation to purify the silane product. (WDM)

10409 (ERDA/JPL—954373-75/1) **Heat exchanger: ingot casting/slicing process. Silicon sheet growth development for the large area silicon sheet task of the low cost silicon solar array project. First quarterly report, November 20, 1975—December 31, 1975.** Schmid, F. (Crystal Systems, Inc., Salem, Mass. (USA)). 31 Dec 1975. 15p. Dep. NTIS $3.50.

Designs for changes to the existing crystal casting furnace and multi-wafer slicer were completed prior to the contract. Equipment supplies necessary for the modifications and silicon material were ordered during the first one and one-quarter month period covered. Assembly preparation and check-out of all systems are on schedule. (auth)

10410 (PB—238506) **Terrestrial photovoltaic power systems with sunlight concentration. Quarterly report, 1 July—30 September 1974.** Backus, C.E. (Arizona State Univ., Tempe (USA). Engineering Research Center). Oct 1974. 52p. (NSF/RANN/SE/GI—41894PR/74/3). NTIS $4.25.

Prepared in cooperation with Textron, Inc., Sylmar, Calif.

A program was initiated to investigate the basic parametric relationships inherent in a solar system that concentrates sunlight onto solar cells. These relationships can then be used to determine the optimum combination of components that minimize the cost per watt of these systems. Work has progressed in each of the six study tasks: solar cell design, solar concentrator, heat rejection, solar tracker, systems analysis. Specific progress includes: analytic model to characterize cell performance, construction of high irradiance cells, assembly of equipment for high irradiance testing, experiments for empirical evaluation of cell mounting interface, completion of heat rejection model for passive and active cooling of solar cell array, development of insolation and ambient weather model, heat transfer analysis for non-uniform illumination on solar cell array, compilation of heat transfer coefficients for various finned surfaces with passive cooling, and methodology for systems simulation model including cost analysis. (GRA)

10411 (AD/A—005918) **Long-wave sensitivity of solar converters n-CdS-Cu(2-x)S.** Marchenko, A.I.; Pavelets, S.Yu.; Fedorus,

G.A. Translated from *Ukr. Fiz. Zh.* (*Russ. Ed.*); 15: No. 9, 1530-1534(1970). 8p. (FSTC-HT—23-1574-71). NTIS $3.25.

SOLAR THERMAL POWER PLANTS

10412 (COO—2699-2) **Solar power arrays for the concentration of energy technical report covering task 4b. Solar hybrid plants: power system interface analyses.** Albertson, V.D. (Minnesota Univ., Minneapolis (USA). Dept. of Electrical Engineering). Nov 1975. Contract E(11-1)-2699. 19p. Dep. NTIS $3.50.

A model is developed which yields the solar flux density distribution on the surface of a vertical cylindrical receiver mounted on a tower centrally located in a horizontal circular ring-shaped mirror field. The flux density at a given location on the receiver surface is shown to be given by the numerical integration of a simple analytical expression. Strategies are examined for redistributing the solar flux input to obtain a desired distribution or maintain a specified distribution throughout the day. The solar flux density distribution is expressed as a dimensionless concentration ratio which can be derived from universal curves and then used in the design of receivers to meet specified flux levels. (auth)

OCEAN THERMAL GRADIENT POWER PLANTS

10413 (APL/JHU-SR—75-2, pp 185-225) **Panel discussion of questions raised by working groups following the first working group sessions.** Cohen, R.; Douglass, R.; Trimble, L.; Heronemus, W.; Lavi, A.; Avery, W.; Zener, C. Aug 1975.

From Workshop on ocean thermal energy conversion; Houston, Texas, USA (8 May 1975).

In Proceedings, third workshop on ocean thermal energy conversion (OTEC).

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 10884

SPACE HEATING AND AIR CONDITIONING

REFER ALSO TO CITATION(S) 10885, 10886, 10887

10414 (PB—240553) **Assessment of a single-family-residence solar heating system in a suburban development setting. Monthly report.** Phillips, J.D. (Colorado Springs Dept. of Public Utilities, Colo. (USA)). 10 Nov 1974. 38p. NTIS $3.75.

Briefly discussed are problems and costs relating to a solar house heating system that is on automatic control. (GRA)

10415 (PB—240784) **Assessment of a single-family-residence solar heating system in a suburban development setting. Semiannual report, 1 Jul-31 Dec 1974.** Phillips, J.D. (Colorado Springs Dept. of Public Utilities, Colo. (USA)). 10 Jan 1975. 108p. NTIS $5.25.

A solar-heated residence project in Colorado Springs, Colorado is discussed. The house and the heating system are described, and the status of related information-gathering activities is reported in areas affecting solar heating systems, such as legal, social acceptance and economic considerations. Outlines of the technical research being conducted, news clippings, and an analysis of the questionnaires completed by persons visiting the house in July, 1974, are included. (GRA)

WATER HEATING

10416 **Solar energy—thermal conversion system for process applications.** Yang, W.J. (Univ. of Michigan, Ann Arbor). pp 11-14 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

A scheme is developed to utilize solar energy for process applications such as heating, drying, industrial processing, or conversion into electric energy. To compensate limitations on continuity imposed on some solar energy systems by night, clouds, and seasons, a supplementary conventional furnace is installed in the process plant together with a solar-energy storage unit. Thus, steady operation of the system can be ensured by means of process variable monitoring using a sensor and a controller. The system may operate automatically through a feedback control link. With the cost factors and the limitations in time and geography brought under control, the system is economically viable and competitive.

SOLAR COLLECTORS AND CONCENTRATORS

10417 (COO—2600-76/3) **Development of high efficiency collector plates. Final report.** Santala, T.; Sabol, R. (Texas Instruments, Inc., Attleboro, Mass. (USA)). Feb 1976. Contract E(11-1)-2600. 103p. Dep. NTIS $6.60.

Composite metal technology was used to manufacture intermetallic compound (IC) absorption surfaces and to combine them integrally with composite metal tube-in-sheet collector plates. Five material systems in which Al was one component metal and Fe, Cr, or Ni and their alloy was the other pair, were evaluated. All intermetallic compounds had high solar absorptance α approx. = 0.9. The AlNi was most promising and $\alpha >$ or = 0.95 and ϵ approx. = 0.3 were obtained over a broad range of compounding conditions. After eight months exposure in a flat plate collector enclosure the characteristic properties of AlNi surfaces remained virtually unchanged. Only LCS/Cu composite metal tube-in-sheet collector plates could be manufactured successfully. The technical difficulties associated with integrating the intermetallic compound and tube-in-sheet technologies make the manufacturing of composite metal collector plates at the time being economically unfeasible.

10418 **Turning collectors for solar radiation.** Barak, A.Z. (to U.S. Energy Research and Development Administration). US Patent Application 579,179. Filed date 20 May 1975. 10p.

A device is provided for turning a solar collector about the polar axis so that the collector is directed toward the sun as the sun tracks the sky each day. It includes two heat-expansive elements and a shadow plate. In the morning a first expansive element is heated, expands to turn the collector to face the sun, while the second expansive element is shaded by the plate. In the afternoon the second element is heated, expands to turn the collector to face the sun, while the first is shaded by the plate.

GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 10883

RESOURCES AND AVAILABILITY

USA

10419 (LA—6197-MS) **Zuni Mountains, New Mexico as a potential dry hot rock geothermal energy Site.** Laughlin, A.W.; West, F.G. (Los Alamos Scientific Lab., N.Mex. (USA)). Dec 1975. Contract W-7405-Eng-36. 13p. Dep. NTIS $4.50.

Many of the criteria for the successful exploitation of energy from dry hot rock are met in the Zuni Mountains, New Mexico. This area falls within a broad region of abnormally high heat flow on the Colorado Plateau. Within this region, a variety of evidence indicates that local "hot spots" may be present. These "hot spots" are prime targets for dry hot rock exploration. A site-evaluation program utilizing geological, geochemical-geochronological, and geophysical techniques is proposed to delineate the optimal sites for subsequent exploratory drilling.

10420 (LA-UR—76-369) **Geothermal energy for power generation.** Tester, J.W. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 8p. (CONF-760416—1). Dep. NTIS $3.50.

From IEEE region six conference; Tucson, Arizona, United States of America [8]USA[8] (7 Apr 1976).

The magnitude of the geothermal resource base for natural hydrothermal systems and for artificially stimulated dry hot rock systems is evaluated for the United States with respect to necessary technology required for development. The utilization of geothermal fluids ranging in temperature from 100 to 300°C is discussed from a thermodynamic and economic viewpoint. Direct steam flashing and a number of binary-fluid Rankine cycle arrangements employing nonaqueous working fluids are compared as to the performance of their power conversion cycle. In addition, the status of component development for advanced geothermal conversion systems is discussed. A [3]generalized cost model is developed for predicting electric generating costs as a function of characteristics of the resource, including geothermal temperature gradient, reservoir capacity, and fluid temperature.

10421 (SAN—1077-1) **Susanville Geothermal Energy Project. Quarterly report, October 10, 1975.** Longyear, A.B. (City of Susanville, Calif. (USA)). 10 Oct 1975. Contract AT(04-3)-1077. 33p. Dep. NTIS $4.00.

The first quarterly report on the status of the Susanville Geothermal Energy Project outlines the research plan, institutional plan, utilization plan, and program plan. Each task includes a description of scope; a definition of current status; an identification of key results or findings; a definition of problems and solutions being undertaken or recommended; and a highlighting of key future activities. The first quarter effort has concentrated in organizing for and initiating data collection and analysis. (LBS)

SITE GEOLOGY, HYDROLOGY, AND METEOROLOGY

USA

REFER ALSO TO CITATION(S) 10419

10422 (COO—2687-3) **Development of an assessment methodology for geopressured zones of the upper Gulf Coast based on a study of abnormally pressured gas fields in South Texas. Progress report, 1 December 1975—29 February 1976.** Swanson, R.K.; Oetking, O.; Osoba, J.S.; Hagens, R.C. (Southwest Research Inst., San Antonio, Tex. (USA)). Feb 1976. Contract E(11-1)-2687. 30p. Dep. NTIS $4.00.

Twenty-four separate gas fields producing from geopressured sands have been identified in the South Texas area that includes Hidalgo, Cameron, Willacy and the lower half of Kenedy Counties. Of these, twenty are in Hidalgo County. Geological study and detailed investigation of reservoir parameters in each of the fields have been accomplished. Two areas in particular are discussed in some detail in this paper: the Vicksburg Trend on the west, represented by McAllen Ranch Field, and the south central Frio-Vicksburg delta, including the McAllen-Pharr-Edinburg area. The depth of the geopressured zone in the study area ranges from 7,000 feet in western Hidalgo County to 12,000 feet in the central Cameron County. Temperature data within the fields, corrected to equilibrium values, yields a 300°F isogeothermal surface at depths of 10,500 feet to 14,000 feet over the study area. The most critical reservoir parameter was found to be the effective permeability in all the fields in the region. Permeability values ranged from 0.03 md to 8.0 md, with average values over all the fields near 1.0 md. A permeability profile of McAllen-Pharr shows permeability there to be an inverse function of depth, with effective permeability values from 16 md above the geopressured zone to 0.03 md at 14,000 feet. The permeability reduction amounts to approximately one order of magnitude for each 2,000 feet of depth.

REGULATIONS

REFER ALSO TO CITATION(S) 10888

ECONOMICS

10423 (BNWL-SA—5596) **Economic analysis of geothermal energy costs.** Bloomster, C.H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 33p. (CONF-751107—17). Dep. NTIS $4.00.

From 68. annual meeting of American Institute of Chemical Engineering; Los Angeles, California, USA (16 Nov 1975).

A description is given of the computer program, GEOCOST, and its application to some analyses of the economics of geothermal energy. GEOCOST combines both technical and economic factors into one systematic cost accounting framework. The program, which simulates production of electricity from most types of geothermal resources, is composed of two parts: a reservoir model which simulates the costs associated with the exploration, development, and operation of a geothermal reservoir; and a power-plant model which simulates the costs associated with the design, construction, and operation of the power plant. The costs from the reservoir model become the energy supply costs to the power plant. The combined reservoir and power plant models represent the complete energy production system. (LBS)

GEOTHERMAL POWER PLANTS

DESIGN AND OPERATION

10424 (ANCR—1281) **Geothermal R and D project report, July 1, 1975—September 30, 1975.** (Idaho National Engineering Lab., Idaho Falls (USA)). Dec 1975. Contract E(10-1)-1375. 54p. Dep. NTIS $5.50.

The Idaho National Engineering Laboratory (INEL) Geothermal Research and Development Project is conducting two major geothermal development efforts: (1) a project aimed at medium temperature (approximately 300°F) utilization to produce electricity with supplemental direct thermal use of the energy and (2) a low temperature (approximately 170°F) space heating project. The first effort has progressed in the field to the successful drilling of two deep geothermal wells providing flows of the desired temperature in the Raft River Valley of Southcentral Idaho. The second program involves the heating of government buildings and a university campus at Boise, Idaho. This report covers the period July 1 to September 30, 1975.

10425 (ANCR—1295) **Geothermal steam plant modeling and power tradeoff studies.** Shaffer, C.J. (Idaho National Engineering Lab., Idaho Falls (USA)). Jan 1976. Contract E(10-1)-1375. 60p. Dep. NTIS $5.50.

A computer model of an open loop flashed steam plant for producing electrical power from a hot geothermal water supply is documented. The model has the capability of tracing the dissolved gases, N_2 and CO_2, throughout the plant. Sensitivity studies were performed on several of the geothermal source, design, and atmospheric parameters using the source conditions found in the Raft River Valley as a base case.

POWER CONVERSION SYSTEMS

REFER ALSO TO CITATION(S) 10390, 10424

10426 (LBL—4404) **Optimization of thermodynamic efficiency in binary-type geothermal electric power generating plants.** Eno, E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1975. Contract W-7405-Eng-48. 24p. NTIS.

Calculations and curves are presented which prove that for each turbine entry temperature, there is an entry pressure which will optimize the thermodynamic efficiency of a "binary" type geothermal power plant. Comparisons are made between thermodynamic efficiency and another method of rating process efficiency.

GEOTHERMAL ENGINEERING

CORROSION AND SCALING

10427 (COO—2607-2) **Study of silca scaling from geothermal brines. Semiannual progress report May 15, 1975—November 14, 1975.** Harvey, W.W.; Offenhartz, P.O.D.; Pearson, G.F.; Slaughter, J. (Eic, Inc., Nowton, Mass. (USA)). Jan 1976. Contract E(11-1)-2607. 56p. Dep. NTIS $4.50.

Further studies have been made of factors influencing the rate of rejection from true solution of excess silica contained in geothermal brine. Prominent influences on the course of this precursor step in silica scaling include degree of supersaturation with respect to silicic acid monomer, concentration of dissolved salt, brine pH and temperature. Most of the measurements were made at 95°C, an especially pertinent temperature because it approximates that of a hot brine after flashing. Concurrent analyses for silicic acid monomer and total dispersed silica in a 2 percent brine at 95°C and pH 5 revealed a growth and decay of nonmonomeric silica concentration, superimposed on the disappearance of monomer. Consistent with this behavior, the nonmonomeric species eventually precipitated out of solution (as floc or as scale), while the monomer concentration approached a saturation value characteristic of the brine composition and temperature. The observed sequence suggests that monomer combines with polymeric species, and the latter grow and aggregate into flocculent silica or scale. A practical implication of these results is the possible retardation of scaling through inhibition of silica polymerization.

SAFETY AND CONTROL

REFER ALSO TO CITATION(S) 10839, 11438

ENERGY UTILIZATION

REFER ALSO TO CITATION(S) 10424

10428 (UCRL—51926) **Present status and future prospects for nonelectrical uses of geothermal resources.** Howard, J.H. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Oct 1975. Contract W-7405-Eng-48. 168p. Dep. NTIS $7.60.

This report, which is part of a study initiated by the NATO Committee on the Challenges of Modern Society (CCMS), describes the current status of nonelectrical uses of geothermal resources. Such resources are defined as geothermal fluids between the temperatures of 50 and 160°C. Current and potential uses of these resources including residential and commercial, agricultural and industrial applications are described. Also discussed are exploration and drilling; extraction and distribution; environmental impact; and economic and regulatory problems. Applications in a number of countries are described. Among the report's conclusions are: (1) Geothermal resources are widely distributed throughout the world. (2) The extraction of these resources presents no serious technical problems. (3) A wide variety of economically viable applications for these resources currently exists. (4) Current nonelectrical applications have a favorable economic structure compared with those of other energy sources. (5) Disposal of spent fluids has a significant ecological impact. Reinjection appears to be the most likely alternative. (6) The legal and institutional framework surrounding these applications needs both clarification and simplification.

TIDAL POWER

REFER ALSO TO CITATION(S) 10883

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 10839, 11438

WIND ENERGY

REFER ALSO TO CITATION(S) 10846, 10883

AVAILABILITY (CLIMATOLOGY)

10429 (UCRL—50034-76-1) **Wind power studies: initial data and numerical calculations. Progress report, September—December 1975.** Hardy, D.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1975. Contract W-7405-Eng-48. 44p. Dep. NTIS $4.00.

Initial data collection and numerical modeling results in wind-energy research conducted by the Lawrence Livermore Laboratory are reported. The use of conventional and laser anemometry is described. Also discussed is the development of a data-collection and data-processing capability appropriate for a major numerical study of wind energy as well as a three-dimensional numerical model of wind fields over complex terrain. Illustrative numerical calculations of nondivergent vector wind fields are presented. (auth)

ECONOMICS

REFER ALSO TO CITATION(S) 10430

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 10839

WIND ENERGY ENGINEERING

10430 (TAC-W—75-700) **Wind energy utilization. A bibliography with abstracts. Cumulative volume 1944/1974.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). 1975. 503p. Dep. NTIS $28.25.

Citations in this wind energy bibliography are listed under the following headings: general; utilization; wind power plants; wind power generators; wind machines; wind data and properties; energy storage; and related topics. Indexes are included for authors, corporate sources, titles, and keywords. (DCC)

TURBINE DESIGN AND OPERATION

10431 (N—74-31527) **Preliminary design of a 100 kW turbine generator.** Puthoff, R.L.; Sirocky, P.J. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1974. 22p. (NASA-TM-X—71585; E—8037). NTIS $3.25.

From International Solar Energy Society meeting; Fort Collins, Colorado, USA (21 Aug 1974).

The National Science Foundation and the Lewis Research Center have engaged jointly in a Wind Energy Program which includes the design and erection of a 100 kW wind turbine generator. The machine consists primarily of a rotor turbine, transmission, shaft, alternator, and tower. The rotor, measuring 125 feet in diameter and consisting of two variable pitch blades, operates at 40 rpm and generates 100 kW of electrical power at 18 mph wind velocity. The entire assembly is placed on top of a tower 100 feet above ground level. (auth)

10432 **Wind turbine.** Blackwell, B.F.; Feltz, L.V.; Maydew, R.C. (to U.S. Energy Research and Development Administration). US Patent 3,918,839. 11 Nov 1975. Filed date 20 Sep 1974. 10p. PAT-APPL-508,016.

A wind turbine rotatable about a shaft is described which includes a drive rotor with one or more elongated blades each having a central outwardly curved portion of airfoil shape which produces rotary motion when the blade rotates in wind at a blade tip velocity to wind velocity ratio greater than about three or four. Additional wind rotor means are disposed at both ends of the curved portions of the elongated blade for rotatably accelerating the drive rotor to the desired velocity ratio. (Official Gazette)

ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 10464, 10793, 10892, 10897

10433 (CONF-740936—) **Research in electric transmission and distribution: the university's role. Proceedings of the Workshop held at the State University of New York at Buffalo, September 30 and October 1, 1974.** (State Univ. of New York, Buffalo (USA)). 1974. 217p. State Univ. of New York, Buffalo.

From Conference on research in electric transmission and distribution; Buffalo, New York, USA (30 Sep 1974).

Ten papers were presented at the conference. Seven papers were abstracted for ERA and two of these also appear in NSA. Three papers were previously processed for the energy data base. (RCK)

POWER GENERATION

REFER ALSO TO CITATION(S) 10255, 10412, 10856, 10896, 10908

10434 (UCRL—50028-75-2, pp 46-51) **Combustion research group.** 1975.

In H-Division quarterly report, April—June 1975.

The objective of this program is to provide the theoretical and experimental basis for the design of efficient combustion systems. The major thrust of the program is in the area of numerical simulations and computer modeling. The experimental work will be in conjunction with the theoretical work and is intended to provide tests and data for refining the numerical simulations. In the previous H-Division quarterly report some aspects of the high speed Schlieren photography planned for the investigation of combustion dynamics was discussed. In this report some theoretical studies that are currently underway are described.

10435 **Efficiencies in energy conversion.** Blackwood, T.R. (Monsanto Research Corp., Dayton, OH). pp 36-44 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

An introductory view is presented of the following methods of using or converting energy: conventional boiler; conventional boiler plus flue gas cleaning; pressurized fluid bed combustor; atmospheric fluid bed combustor; low Btu gas generator; high Btu gas generator; coal liquefaction; conversion of coal or methanol; coal cleaning plant; chemical coal cleaning systems; residual oil desulfurization; chemically active fluid bed; steam turbine; gas turbine; combined cycle (gas and steam); nuclear power plants; Feher cycle; potassium topping cycle; bottoming cycle; magnetohydrodynamics (MHD); fuel cells; automotive; and diesel. The thermodynamic limiting present day (1974) and expected future (1990) efficiencies are compared in tabular form. This is followed by a short discussion of the efficiency-limiting factors and possible general routes for process improvement.

COOLING SYSTEMS

10436 Perspective of dry cooling towers for electric power plants. Yang, W.J. (Univ. of Michigan, Ann Arbor). pp 230-234 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

With the demand in electric power doubled in every decade, with the need for a large quantity of water as a heat sink in an electric power plant, and in view of the public outcry on thermal pollution of waterways and reservoirs due to hot effluent discharge from the power plant and on fog-like plume from a wet cooling tower, there is little doubt that dry cooling towers may eventually become an essential element in electric power plants of nuclear as well as fossil type in the future. The prime consideration for an extensive use of a dry cooling tower lies in low total costs of the cooling facility while maintaining high turbine capability. This can be achieved by a significant improvement in the heat discharge capability of dry cooling units: through the use of perforated-fin tubular heat exchangers with spray cooling. (auth)

SOLID-WASTE INCINERATION

REFER ALSO TO CITATION(S) 10401, 10402, 10890

POWER PLANT COMPONENTS

REFER ALSO TO CITATION(S) 11038, 11423

10437 Turboset including a helium turbine and a helium-cooled generator. Abolins, A.; Finckh, H.; Lambrecht, D.; Trabler, M. (to Kraftwerk Union Aktiengesellschaft). US Patent 3,936,651. 15 Jan 1974. Priority date 18 Jan 1973, German, Federal Republic of (F.R. Germany). vp.

A turboset is described. It is comprised of one engine room filled with helium, a helium turbine mounted in the engine room, and a generator connected to the helium turbine in the engine room. The generator has means defining at least one opening exposing the interior thereof to the helium in the engine room so as to be cooled thereby, and means connecting the interior of the generator to a supply of helium outside the engine room having a helium pressure lower than the helium pressure in the engine room.

10438 Effect of gas turbine efficiency and fuel cost on cost of producing electric power. Hedley, W.H. (Monsanto Research Corp., Dayton, OH); Foley, G. pp 21-23 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

The relationship between gas turbine efficiencies and fuel costs ranging between 40 and 100 cents per million Btu on the cost of power in mils per kilowatt hour is discussed for power production in a combined cycle gas-turbine/steam-turbine system. Improvements in gas turbine efficiency from the present 29% to 37% are envisioned over the next 9 years, which would result in combined cycle efficiencies from 42 to 54%. Those improvements would reduce power costs (neglecting inflation) from 8 to 6.5 mils per kilowatt hour for 40 cents per million Btu fuel and from 13 to 10.5 mils for 100 cents per million Btu fuel. Power costs are considerably more sensitive to fuel prices than to gas turbine efficiencies, although increasing efficiencies will have a beneficial effect on both costs and quantity of power produced. The research needs in the gas turbine technology are also discussed. The research improvements envisioned which would improve the efficiency of the gas turbine are primarily those which will increase the temperature at which the gas turbines can operate. It is predicted that with adequate funding the R and D effort could be expected to increase the turbine inlet temperature by from 60 to 90°F per year up to 2600°F by 1982, which is enough to increase gas turbine efficiency at the rate of almost 1% per year. R and D will also be required to develop dry control technology for NO/sub x/ control so that high inlet temperatures can be utilized without excesive emissions.

10439 Problem of determining the effectiveness of air preheating at power stations. Apatovskii, L.E.; Lokshin, V.A.; Fomina, V.N.; Khalupovich, V.A. *Therm. Eng.* (*USSR*) (*Engl. Transl.*); 22: No. 2, 17-18(1975).

Translated from Teploenergetika; 22: No. 2, 23-24(1975).

The effects of air preheating on the cost of power produced by steam turbine generating plants and difficulties in determining these effects are discussed. (LCL)

10440 Full-scale tests of the exhaust hoods of a high-capacity steam turbine. Lagun, V.P.; Simoyu, L.L.; Frumin, Yu.Z. *Therm. Eng.* (*USSR*) (*Engl. Transl.*); 22: No. 2, 27-32(1975).

Translated from Teploenergetika; 22: No. 2, 31-35(1975).

Full-scale tests performed to determine the effect of exhaust hood designs on the efficiency of high-capacity steam turbines are described. On the whole, the result of the investigations confirmed that the efficiency of operation of the exhaust hood is affected by the inlet conditions, determined by the operation of the last stage, and by its geometry. In particular, the efficiency of use of the passage sections of the hood and the resulting losses of the total leaving velocity are greatly affected by the distribution of flows and velocities over the radius of the stage. With allowance for the nonuniformity of distribution of these parameters, one should plan and perfect the geometry of exhaust hoods of high-capacity steam turbines. (LCL)

10441 Investigation of the influence of blade outlet angle and blade height on the efficiency of a shrouded reaction turbine stage. Pshenichnyi, V.D.; Rozenthal, V.V. *Therm. Eng.* (*USSR*) (*Engl. Transl.*); 22: No. 2, 33-35(1975).

Translated from Teploenergetika; 22: No. 2, 36-38(1975).

A wide range of variation of heights and angles of turbine stages with non-twisted blading were tested to determine the optimal blade outlet angle for a given throughput overall operating characteristics of turbine stages and turbine efficiency. The results agreed with and extended the range of well-known data. (LCL)

10442 Investigating the possibility of equalizing the gas temperature distribution in a model of the mixing zone of a gas turbine plant combustor. Bezmenov, V.Ya.; Onishchik, L.I. *Therm. Eng.* (*USSR*) (*Engl. Transl.*); 22: No. 2, 47-50(1975).

Translated from Teploenergetika; 22: No. 2, 46-49(1975).

Results are presented of an investigation into the equilization of several types of nonuniformity, particularly temperature distribution, of combustion product flow in a model of a mixer of a gas turbine plant combustor. (LCL)

10443 Calculation, testing and construction of superheated-steam-conducting pipes, steam mains and fittings. Burgbacher, G. (Technischer Ueberwachungs-Verein Stuttgart e.V. (F.R. Germany)). *Tech. Ueberwach.*; 16: No. 6, 165-171(Jun 1975). (In German).

25 figs.; 3 tabs.; 30 refs.

The susceptibility to failures of the superheated steam-conducting system of power plants has given rise to some reflections on the lifetime of these constructional parts. The present study of the superheated steam-conducting system of an older plant show that all these parts necessitate constant monitoring of the operational process as well as repeated controls for the estimation of their lifetime in order to ensure safe operation of the plant. (DE)

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 10889

10444 (PB—240280) Soil and air temperature changes induced by subsurface line heat sources. Special report. Rykbost, K.A.; Boersma, L. (Oregon State Univ., Corvallis (USA). Agricultural Experiment Station). Dec 1973. 109p. NTIS $5.25.

Multiple use of waste heat from power plants may become an important consideration in their development and siting. The heat in the cooling water must be considered a resource to be managed for effective use. Soil warming was suggested as one of several possible productive uses for the heated discharges. The sub-surface application of heat to soil by circulating the warm water through a network of buried pipes was proposed and studied. In regions where soil temperatures limit plant growth, artificial soil warming may be an economically feasible practice. This

hypothesis was evaluated in the soil warming experiment. Energy balances and water regimes of soils heated above natural temperatures are described. (GRA)

10445 Efficiency of district heating gas turbine installations. Sazanov, B.V. (Moscow Power Inst.). *Therm. Eng. (USSR)* (*Engl. Transl.*); 22: No. 2, 51-57(1975).

Translated from Teploenergetika; 22: No. 2, 49-54(1975).

10446 Improving the utilization of energy. Present and future possibilities. Schaefer, H. (Technische Univ. Muenchen (F.R. Germany). Lehrstuhl fuer Energiewirtschaft und Kraftwerkstechnik). *Atomwirtsch., Atomtech.*; 20: No. 9, 423-428(Sep 1975). (In German).

6 figs. Revised lecture of a paper presented at the Reactor conference, Nuernberg, F.R. Germany, 8 Apr 1975.

Groups outside the field of power technology have felt justified in propagating ideas for a more economic use of energy, making it difficult to distinguish between proposals that could be realized and those which could not. The possibilities for an improved utilization of energy are at present limited to the avoidance of unnecessary energy consumption and to reducing the energy requirement for specific applications. Proposals made about the utilization of the waste heat from power plants are often misunderstood, but the technical approaches which have been taken are promising. (DE)

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 10323, 10839, 10906, 10907, 11127, 11230, 11438

10447 (CONF-760107—1) Transmission line aesthetic impact evaluation process and its implementation in the general planning scheme. Rosemarin, C.S.; Wilson, D.L. (Oak Ridge National Lab., Tenn. (USA)). 1976. 27p. Dep. NTIS $4.00.

From International symposium on environmental concerns in right-of-way management; University, Mississippi, United States of America "USA" (6 Jan 1976).

An instrument for the assessment of aesthetic impact of transmission lines was developed at Oak Ridge National Laboratory. Its product is a display of relative impact among cells in the study area. The automated procedure was then fit into a comprehensive routing process. (auth)

THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 11482

10448 Evaluation of thermal discharges from steam electric generating stations. Paretsky, L.C.; Moy, H.C.; Gutti, S.R.; Galya, D.; Szeligowski, J.J. (Consolidated Edison Company of New York, Inc.). pp 216-229 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

Analytical modeling, physical modeling, and field measurements were made for quantifying the intensity of the thermal plume emanating from a steam-electric generating facility. Each method has its virtues and faults. If sufficient hydrological and meteorological information are available, analytical modeling could be employed. The results, however, may be suspect until the model has been verified, although not necessarily verified at the site under consideration. If insufficient physical data are available, the cost to acquire such data could approach the cost of actual field surveys, and the latter could be the preferred approach. The cost of developing an analytical model along with the acquisition of the necessary field data for the input parameters could easily exceed $250,000. Construction and operation of a physical model also requires hydrological data. The cost, without verification, could approach $500,000. (LCL)

NOXIOUS GAS CONTROL

REFER ALSO TO CITATION(S) 10246, 10248, 10249, 10250, 10840

10449 Method for removing sulfur dioxide from a combustion exhaust gas. Morita, T.; Funahashi, I. (to Kureha Kagaku Kogyo Kabushiki Kaisha). US Patent 3,935,296. 8 Nov 1973. Priority date 10 Nov 1972, Japan. vp.

A method is described for removing sulfur dioxide in the form of calcium sulfite from a sulfur dioxide-containing combustion exhaust gas, comprising the steps of: feeding a portion of the combustion exhaust gas to a sulfuric acid solution to produce sulfurous acid in the solution and a gas exhaust and then oxidizing the sulfurous acid with air or oxygen in the presence of an oxidizing catalyst to produce sulfuric acid; feeding the remaining portion of the combustion exhaust gas and the gas exhausted to an aqueous solution of alkali sulfite to produce an aqueous solution of alkali bisulfite and alkali sulfate; mixing a major portion of the aqueous solution of alkali bisulfite produced with slaked lime or limestone for reaction to give a reaction solution containing calcium sulfite; and separating calcium sulfite from the reation solution obtained in step (3), the filtrate separated in step (4) being circulated to step (2), and the minor portion of the aqueous solution of alkali bisulfite produced in step (2) being mixed with sulfuric acid produced in step (1) and with a portion of calcium sulfite separated in step (4) thereby to convert the alkali sulfate, which is secondarily produced in the aqueous solution of alkali bisulfite, into gypsum.

10450 Comparison of energy-related costs for particulate control equipment. Osborne, M.C. (Environmental Protection Agency, Research Triangle Park, NC). pp 190-193 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

Electric power generating facilities throughout the world are predominantly using electrostatic precipitators as their primary means of removing particulate emissions. However, current economic research conducted by EPA and the major control equipment manufacturers indicates that capital costs for baghouses and precipitators are comparable, most favorably so on power plants burning low sulfur coal. A "Control Equipment Design and Analysis" computer program (CEDA) is used to compare equivalent fabric filter and electrostatic precipitator designs. The results of the computer simulation of one mid-west power plant indicate that although either a baghouse or an electrostatic precipitator could be built for roughly the same cost, the baghouse would use more than twice as much energy during operation. When general maintenance costs were also considered, the baghouse became even less economical. Therefore, the computer model clearly shows that in power plants where construction costs for baghouses and precipitators are nearly equal, power and maintenance costs greatly favor the installation of precipitation equipment. (auth)

SITE SELECTION

REFER ALSO TO CITATION(S) 10830, 11471

10451 (PPSP-CEIR—1) Power plant cumulative environmental impact report. (Maryland Dept. of Natural Resources, Annapolis (USA)). Sep 1975. 200p. Department of Natural Resources, Annapolis, MD.

Objectives of the siting program are to provide adequate electric energy at reasonable cost, to improve environmental quality, and to protect natural resources. Some topics considered are electrical demand and consumption in Maryland; electrical power generation and power plant siting; airborne effects of power plants; aquatic impact; radiological effects of nuclear power plants; and social and economic considerations. (HLW)

POWER TRANSMISSION AND DISTRIBUTION

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

10452 (BNL—18762) BNL materials research for an ac superconducting power transmission cable. Gurinsky, D.H. (Brookhaven National Lab., Upton, N.Y. (USA)). 1 Apr 1974. 36p. (CONF-740448—1). Dep. NTIS $5.00.

From Program exchange for Brookhaven and USSR transmission line work meeting; Washington, District of Columbia, USA (8 Apr 1974).

The program on materials which was performed to improve the superconductors for ac superconducting power transmission applications is described. The conclusions previously reached concerning the superconductor for ac power transmission was that the A-15 superconductor Nb_3Sn showed the greatest promise of meeting the requirements for a transmission cable since it had a high critical temperature, critical current and critical field. These properties permit higher operating temperatures (6 to 8°K) with lower

refrigeration costs and single phase He cooling. The high critical temperature is also desirable to cope with fault conditions which may arise in an operating transmission line. The ac loss measurements on commercial Nb_3Sn superconductor tapes fall in the range of 50 to 100 $\mu W/cm^3$ at currents of 500 A/cm at 4.2°K. Although designs for a cable could be made with this level of losses, it was decided that an objective of the materials program should be the reduction of these losses by a factor of 2 to 4. The program which followed continued the evaluation of available commercial Nb_3Sn tapes and special tapes from commercial producers; in addition a metallurgical study was made of the factors which might contribute to losses in commercial tapes. Original methods were developed to fabricate tape and cylindrical specimens for ac loss measurements. (auth)

10453 (CONF-740936—, pp 51-58) **Research on vacuum insulation for cryocables.** Graneau, P. (Underground Power Corp., Cambridge, MA). 1974.

From Conference on research in electric transmission and distribution; Buffalo, New York, USA (30 Sep 1974).

In Research in electric transmission and distribution: the university's role.

Vacuum insulation, as compared with solid insulation, simplifies the construction of both resistive or superconducting cryogenic cables. The common vacuum space in the cable can furnish thermal insulation between the environment and the cryogenic coolant, provide electrical insulation between conductors, and establish thermal isolation between go- and return-coolant streams. The differences between solid and vacuum high voltage insulation are discussed, and research on the design, materials selection, and testing of vacuum insulated cryogenic cables is described. (LCL)

10454 (CONF-740936—, pp 59-65) **University's role in research on superconducting power transmission.** Forsyth, E.B. (Brookhaven National Lab., Upton, NY). 1974.

From Conference on research in electric transmission and distribution; Buffalo, New York, USA (30 Sep 1974).

In Research in electric transmission and distribution: the university's role.

Power transmission by superconducting cables appears to have enormous potential for the utility industry. It has still to be demonstrated that it will become a viable and economically competitive technology, however, development aimed at this goal by major research establishments has already exposed numerous research problems suitable for investigation by well qualified university departments without requiring large expenditures for equipment. What is missing in an organizational structure to relate work to the primary goals, monitor progress and influence the funding decisions of the major agencies. This does not seem difficult to set up, but continued success will require a long-term commitment from the participants. (auth)

10455 (LA—6171-PR) **USERDA Division of Electric Energy Systems dc superconducting power transmission line project at LASL. Progress report No. 10, April 10—June 30, 1975.** Keller, W.E.; Taylor, R.D. (comps.). (Los Alamos Scientific Lab., N.Mex. (USA)). Dec 1975. Contract W-7405-eng-36. 28p. Dep. NTIS $5.00.

The tenth progress report of the Los Alamos Scientific Laboratory dc Superconducting Power Transmission Line (SPTL) Development Project covers the period April 1 to June 30, 1975. A number of line configurations, including a high voltage dc SPTL design, are examined from a cryoengineering point of view. New calculations on the cryostabilization of the superconductors are presented. Measurements of the critical current on several new superconductors and on a 20-m, well-stabilized Nb_3Sn tape are reported. Acoustical emission is being evaluated as a new technique to predetermine damage to Nb_3Sn conductors during cable fabrication. (auth)

10456 (ORNL/TM—5210) **Cryogenic power transmission technology: cryogenic dielectrics. Quarterly report, April 1—June 30, 1975.** (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 85p. Dep. NTIS $6.00.

During this reporting period, April 1 to June 30, 1975, ac dielectric breakdown and partial discharge measurements were carried out on several new polyolefin films immersed in liquid helium at atmospheric pressure. The average breakdown strengths ranged from 135 to 220 MV/m, and were close to the breakdown strengths for the other materials already tested. Analysis of the partial discharge inception voltages for all of the materials tested so far shows that the major determinant of partial discharge inception is the breakdown voltage of the helium layer in series with the film. In other experiments on Valeron polyethylene with both film and electrodes completely encapsulated by epoxy, breakdown occurred with no observable partial discharge. The partial discharge sensitivity was the same as used for the unencapsulated film experiments. The breakdown strength with encapsulation was slightly higher than without. The temperature was varied from 4.2 to 300°K, but no influence on the breakdown strength was observed. Breakdown tests with ac voltage were carried out on liquid helium between ASTM electrodes. The peak breakdown voltages measured on the first run were somewhat lower than the previously measured dc voltages. After repolishing the electrodes, another run in which both dc and ac breakdown voltages were taken showed good agreement. However, the voltages were now about 30 percent higher than those of the first run, and were close to the ASTM standard for C-10 oil. It is suspected that contamination in the helium is responsible for the variable results. (auth)

10457 **Power transmission via the superconducting cable.** Haid, D.A. (Union Carbide Corp., Tarrytown, NY). *Mech. Eng.*; **98**: No. 1, 20-25(Jan 1976).

Underground superconducting ac transmission cables with capacities to 4000 MVA are under development to meet the expected urban loads in the 1990s. Such cable systems will be needed to provide the utilities with a solution for transmitting bulk power underground in an environmentally acceptable and reliable manner. In addition, a superconducting cable promises lower losses and higher transmission efficiencies in spite of its need to be refrigerated to a very low operating temperature. Topics discussed include: (1) current research in the power industry; (2) basic cable design; (3) the impact of rising fuel costs; and (4) the availability of helium. (auth)

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 10760, 10878

10458 (ANL-CT—76-23) **Dynamic Simulator for Nuclear Power Plants (DSNP).** Saphier, D. (Argonne National Lab., Ill. (USA)). Jan 1976. 36p. Dep. NTIS $4.00.

A new simulation language DSNP (Dynamic Simulator for Nuclear Power Plants) is being developed. It is a simple block oriented simulation language with an extensive library of component and auxiliary modules. Each module is a self-contained unit of a part of a physical component to be found in nuclear power plants. Each module will be available in four levels of sophistication, the fourth being a user supplied model. A module can be included in the simulation by a single statement. The precompiler translates DSNP statements into FORTRAN statements, takes care of the module parameters and the intermodular communication blocks, prepares proper data files and I/O statements and searches the various libraries for the appropriate component modules. The documentation is computerized and all the necessary information for a particular module can be retrieved by a special document generator. The DSNP will be a flexible tool which will allow dynamic simulations to be performed on a large variety of nuclear power plants or specific components of these plants. (auth)

10459 (CONF-750758—(Summ.)) **Summaries of papers presented at the meeting on small nuclear reactors for industrial energy, Oak Ridge, Tennessee, July 31, 1975.** (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. 160p. Dep. NTIS $6.75.

From Meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America "USA" (31 Jul 1975).

Separate abstracts were prepared for each of the 11 papers included. (JWR)

10460 (CONF-750758—(Summ.), pp 139-152) **Utilization of nuclear power for department of defense installations.** Nida, A.V. (U.S. Army Facilities Engineering Support Agency, Fort Belvoir, VA). Oct 1975.

From Meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America "USA" (31 Jul 1975).

In Summaries of papers presented at the meeting on small nuclear reactors for industrial energy.

A study on the economic and environmental considerations of using small nuclear power plants at Dept. of Defense installations is described. The applications considered included electric power generation, process energy, or a combination of both. Preliminary results indicate that nuclear plants may offer an economical alternative to fossil fueled plants. (JWR)

10461 (CONF-750758—(Summ.), pp 153-159) **Markets for small reactors.** Anderson, T.D. (Oak Ridge National Lab., TN). Oct 1975.

From Meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America "USA" (31 Jul 1975).

In Summaries of papers presented at the meeting on small nuclear reactors for industrial energy.

The potential foreign market for small reactors is discussed for both developed countries and the developing countries. (JWR)

10462 (CONF-750758—(Summ.), pp 63-72) **Barge-mounted systems: siting concepts.** Scheppele, K.L. (Gibbs and Hill, Inc., New York). Oct 1975.

From Meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America "USA" (31 Jul 1975).

In Summaries of papers presented at the meeting on small nuclear reactors for industrial energy.

Concepts are described for siting platform-mounted nuclear plants at the location of industrial facilities where these plants would furnish industrial process heat and/or electrical power. These concepts include a wet emplacement and a dry emplacement situated at a representative industrial site that could be considered typical of sites along navigable canals adjacent to the ocean or along inland waterways.

10463 (NP—20813) **Quality assurance program, DUKE-1. Amendment 1.** Lee, W.S. (Duke Power Co., Charlotte, N.C. (USA)). 1 Oct 1974. 58p. Duke Power Co., Charlotte, NC.

The Duke Power Company quality assurance program for all phases of its nuclear power plants is presented. The organization and program for quality assurance during the design, initial procurement, construction and operation of nuclear power plants is presented. Included in this section are organization charts, a listing of quality assurance and technical functions, and point-by-point comparisons of the Engineering Quality Assurance Program and Construction Quality Assurance Program with the 18 criteria of 10CFR50, Appendix B. (auth)

10464 PROCEEDINGS OF THE AMERICAN POWER CONFERENCE. VOLUME 37. CONFERENCE HELD AT CHICAGO, ILLINOIS, APRIL 21—23, 1975. Chicago; American Power Conference (1975). 1269p. (CONF-750469—). $25.00.

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

Papers are presented on the broad aspects of the electric power industry and related fields of activity. Thirty-two of the papers are abstracted individually for Nuclear Science Abstracts (NSA), 22 for ERDA Energy Research Abstracts (ERA), 22 for Energy Abstracts for Policy Analysis (EAPA), and 73 for the ERDA Energy Data Base only. One paper appeared previously in NSA as CONF-750469-1. (LMT)

10465 Effective use of minicomputers and maxicomputers in the nuclear industry. Fernbach, S. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.*; **22**: 287-288(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10466 (JPRS—66768) **Translations on Eastern Europe.** 11 Feb 1976. Translation of Scientific Affairs No. 499. 50p. NTIS.

Translations of articles from Meres Es Automatika are presented. A separate abstract is included for one article. (JWR)

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 10571, 10574, 10576, 10581, 10583, 10594, 10595, 10672, 10674, 10683, 10695, 10696, 10697, 10698, 10699, 10704, 10705, 10713, 10714, 10716, 10717, 10718, 10752

10467 (NP—20793) **Mixed oxide fuel: scope, procedures, and schedule for generic environmental impact statement and criteria for interim licensing actions.** Chilk, S.J. (Nuclear Regulatory Commission, Washington, D.C. (USA)). 11 Nov 1975. 45p. NRC, Washington, DC.

This notice sets forth the Commission's determination that the subject of wide-scale use of mixed oxide fuel in the light water power reactor fuel cycle requires a full assessment of safeguards issues before the Commission's decision is made; specifies the procedures and schedule to be followed for completion of the environmental impact statement on wide-scale use of mixed oxice fuel and for the conduct of the associated hearings; and sets forth criteria under which certain licensing actions can proceed in the interim prior to the Commission's decision on the wide-scale use of mixed oxide fuel.

10468 (NP—20825) **Failure analysis of a 304 stainless steel Schedule 80 reducer. Final report.** Buchheit, R.D.; Berry, W.E.; Strabel, G.R.; McCall, J.L. (Battelle Columbus Labs., Ohio (USA)). 26 Aug 1974. 67p. Battelle Columbus Labs., OH.

For Yankee Atomic Electric Co., Westboro, MA.

A failure analysis of a Schedule 80 reducer from the Vermont-Yankee boiling water reactor is described. The analysis was conducted using primarily electron and optical metallographic techniques, and electron microprobe, x-ray diffraction, and gamma-ray analytical techniques. The conclusion from the analysis is that the fracture occurred by stress-corrosion cracking due to a high concentration of stresses at a circumferential ID surface machining groove in combination with an unidentified corrodent. The latter stages of the fracture involved a fatigue mode of crack propagation.

10469 Startup operation of Browns Ferry's 1152-MW nuclear units. Calhoun, J.R. (Tennessee Valley Authority, Chattanooga); Green, H.J.; Beers, R.B. *Proc. Am. Power Conf.*; **37**: 90-95(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

An overview is presented of startup operation for the Browns Ferry-1 reactor, and comparisons are made with the startup of Browns Ferry-2. Included are comments on the selection of the BWR type steam supply system, reactor fueling, problems encountered, and plant availability. (DG)

10470 Intergranular stress-assisted corrosion cracking of austenitic alloys in water-cooled nuclear reactors. Cheng, C.F. (Argonne National Lab., Ill. (USA)). *J. Nucl. Mater.*; **57**: No. 1, 11-33(Jul 1975).

Corrosion-cracking incidents of structural components and fuel-element cladding in 30 water-cooled reactors have been reported. All pressure boundary penetrations have small seeping leaks, but pipe severance has not occurred. Failures of the nonpressurized boundary components have been limited to small fasteners and screws, none of which have constituted potential nuclear safety hazards, directly or indirectly, nor damage involving other components. The cracking incidents involving Types 304, 304L, and 347 stainless steel, Incoloy 800, and Inconel 600 were attributed to intergranular stress-assisted corrosion cracking associated with (1) oxygen, (2) caustic, or (3) hydrogen. Sensitization increases the susceptibility to cracking in dissolved oxygen, but it is not a factor in caustic solution. Other material conditions, corrective actions, and mechanisms of intergranular stress-assisted corrosion cracking are discussed. (NL)

10471 Method for increasing the burn-up capability of boiling water nuclear reactors containing plutonium-bearing fuel assemblies. Sofer, G.A. (to General Atomic Co.). US Patent 3,910,818. 7 Oct 1975. Filed date 30 Oct 1969. 6p.

The burn-up capability of a boiling water nuclear reactor containing plutonium-bearing fuel assemblies is significantly increased by reducing the void fraction in the core toward the end of the cycle. This reduction is advantageously accomplished by increasing the rate at which water is recirculated. (Official Gazette)

10472 Method and apparatus for removing radioactive gases from a nuclear reactor. Frumerman, R.; Brown, W.W. (to Westinghouse Electric Corp.). US Patent 3,910,817. 7 Oct 1975. Filed date 17 Oct 1972. 6p.

A description is given of a method for removing radioactive gases from a nuclear reactor including the steps of draining coolant from a nuclear reactor to a level just below the coolant inlet and outlet nozzles to form a vapor space and then charging the space with an inert gas, circulating coolant through the reactor to assist the release of radioactive gases from the coolant into the vapor space, withdrawing the radioactive gases from the vapor space by a vacuum pump which then condenses and separates water from gases carried forward by the vacuum pump, discharging the water to a storage tank and supplying the separated gases to a gas compressor which pumps the gases to gas decay tanks. After the gases in the decay tanks lose their radioactive characteristics, the gases may be discharged to the atmosphere or returned to the reactor for further use. (Official Gazette)

10473 Effects of fissile atom segregation in light water reactor plutonium recycle fuels. Meyer, R.O. (Nuclear Regulatory Commission., Washington, DC); Hann, C.R.; Lanning, D.D. *Nucl. Technol.*; **27**: No. 3, 389-393(Nov 1975).

Plutonium segregation during normal operation is not expected in light water reactor (LWR) plutonium recycle fuels, but it could occur if these fuels were operated in a sustained overpower

condition. Existing thermal performance and neutronic computer codes have been used to compare the effects of postulated segregation with the behavior of homogeneous fuels. Central void formation, which should accompany plutonium segregation, reduces fuel temperatures markedly; but even if a central void is assumed not to form, the fuel's centerline temperature, stored energy, and melting point are not significantly affected by the postulated segregation. It is concluded that plutonium segregation is not an important phenomenon in LWR plutonium recycle fuels. (auth)

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 10335, 10467, 10470, 10473, 10569, 10570, 10572, 10573, 10575, 10577, 10578, 10579, 10580, 10582, 10584, 10585, 10594, 10595, 10672, 10674, 10678, 10679, 10680, 10683, 10695, 10698, 10699, 10704, 10705, 10710, 10711, 10713, 10714, 10715, 10716, 10717, 10718, 10719, 10752

10474 (ANCR—1270) **USNRC-OECD Halden Project fuel behavior test program: experiment data report for test assemblies IFA-226 and IFA 239.** Laats, E.T.; MacDonald, P.E.; Quapp, W.J. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Dec 1975. Contract E(10-1)-1375. 235p. Dep. NTIS $10.00.

The experimental data which were obtained from the IFA-226 and IFA-239 test assemblies during operation in the Halden Boiling Water Reactor are reported. Included are cladding elongation, fuel centerline temperature, internal gas pressure, and power history data from IFA-226 which were obtained from November 1971 through April 1974, and cladding elongation, diametral profile, and power history data from IFA-239 covering the period from March 1973 through April 1974. The data, presented in the form of composite graphs, have been analyzed only to the extent necessary to assure that they are reasonable and correct. A description of these mixed oxide fuel test assemblies and their instrumentation is presented. Test pin fabrication history, instrument calibration data, assembly power calibration methods, and the neutron detector data reduction technique are included as appendices. (auth)

10475 (BAW—10026) **Reactor vessel model flow tests for 145-fuel assembly core.** Davis, R.B. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Dept.). Jan 1976. 15p. Babcock and Wilcox, Lynchburg, VA.

Hydraulic tests on a one-sixth-scale model of a two-loop pressurized water reactor with 145 fuel assemblies are described. Core inlet and outlet flow distributions and reactor vessel pressure drop were investigated. The core inlet flow distribution was developed to be independent of the flow conditions in the inlet annulus. A flow distribution system, consisting of several flow splitters in the inlet annulus and a spherical plate flow distributor in the lower head region, was developed to obtain a symmetric and stable core inlet flow distribution. A minimum core inlet flow factor of 0.99 was established in the core. Reactor vessel unrecoverable pressure drops were measured on the model to predict losses that will occur in the prototype.

10476 (BAW—10067(Rev.2)) **Containment isolation valves.** Wrobel, G.J.; Leinhart, D.E. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jan 1976. 14p. Babcock and Wilcox, Lynchburg, VA.

Revised data on containment isolation valves for Babcock and Wilcox PWR's are presented. (JWR)

10477 (BAW—10097A(Rev.2)) **Mark C (17 x 17) fuel assembly. Research and development. Revision 2.** Stoudt, R.H.; Klink, P.H.; Walton, L.A. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jan 1976. 59p. Babcock and Wilcox, Lynchburg, VA.

The research and development programs related to the B and W Mark C (17 x 17) fuel assembly are described. The programs described are designed to provide data for analytical models, confirm predictions, and verify the adequacy of the design. A general description of the Mark C assembly is presented along with comparisons to the Mark B (15 x 15) fuel assembly (the Mark C fuel assembly is an extension of B and W's existing Mark B fuel assembly technology and the planned testing programs draw on the experience gained in the Mark B development program). The report is organized in three main test areas: (1) mechanical and hydraulic, (2) critical heat flux, and (3) rod swelling and burst. The test program scopes and objectives are discussed along with the test methods. (auth)

10478 (BAW—10114) **PROLIB: code to create production library of nuclear data for design calculations.** Wittkopf, W.A.; Tilford, J.M.; Furtney, M. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jan 1976. 93p. Babcock and Wilcox, Lynchburg, VA.

This PROLIB program creates, updates, and edits the production library used in the B and W nuclear design system. The production library contains the material cross section data required to perform the thermal and epithermal spectrum calculations in the NULIF program. PROLIB collapses cross section data from the master libraries, produced by the ETOGM and THOR programs, to the desired production library group structures. The physics models that are used, the calculations that are performed in PROLIB, the input, and the output are described. Information that is required to use PROLIB along with a sample problem that illustrates the input and output formats and that provides a benchmark problem are given. (auth)

10479 (BAW—10124) **FLAME3: a three-dimensional nodal code for calculating core reactivity and power distributions.** Mays, C.W.; Furtney, M. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jan 1976. 57p. Babcock and Wilcox, Lynchburg, VA.

The FLAME 3 nodal code calculates core reactivity and three-dimensional power distributions with thermal-hydraulic feedback effects. It employs variable dimensioning, which permits the user to size his own problem subject to the total core storage of the computer. Lagrange interpolation is used for fitting variable data. This allows any input-dependent variable to be fit versus as many as three independent core variables. A transient xenon capability is included, which enhances the code's usefulness in performing maneuvering analyses. Control rod data are input by node, permitting the treatment of partial-length control rods. The various models, including the programmed equation, are described. (auth)

10480 (CENPD—162(Suppl.1)) **Critical heat flux: correlation for C-E fuel assemblies with standard spacer grids. Part 1. Uniform axial power distribution.** (Combustion Engineering, Inc., Windsor, Conn. (USA)). Jan 1976. 24p. Combustion Engineering, Inc., Windsor, CT.

Responses to NRC questions concerning critical heat flux correlation and supporting data for CE fuel assemblies with standard spacer grids in the case of a uniform power distribution are presented. (JWR)

10481 (CENPD—198) **Zircaloy growth: in-reactor dimensional changes; in Zircaloy-4 fuel assemblies.** (Combustion Engineering, Inc., Windsor, Conn. (USA)). Dec 1975. 34p. Combustion Engineering, Inc., Windsor, CT.

The position of Combustion Engineering (C-E) on the in-reactor growth of Zircaloy-4 fuel assembly components is described. A model relating growth strain to neutron fluence is developed by empirical fit. The data base is divided into three groups to reflect the difference between annealed and cold worked material and to separate fuel rods from non-fueled specimens. A literature discussion of the proposed mechanisms of irradiation growth is included in support of the empirical model. (auth)

10482 (CONF-750758—(Summ.), pp 29-62) **Consolidated nuclear steam generator: pressurized water reactor.** Smith, W.R. (Babcock and Wilcox, Lynchburg, VA). Oct 1975.

From Meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America "USA" (31 Jul 1975).

In Summaries of papers presented at the meeting on small nuclear reactors for industrial energy.

The Consolidated Nuclear Steam Generator (CNSG) reactor concept for industrial energy applications is discussed. Some preliminary studies to determine the economics and competitiveness of the concept are reviewed. (JWR)

10483 (JEN—307) **Fuel management study and cycle nuclear design for PW reactors.** Minguez, E.; Abnert, C.; Aragones, J.M. (Junta de Energia Nuclear, Madrid (Spain)). 1975. 149p. (CONF-750753—1). Dep. NTIS (US Sales Only) $6.00.

From 18. NEA-CRP meeting; Bologna, Italy (9 Jul 1975).

A reference reactor was chosen to do a general study involving Fuel Management Evaluations of several cycles, and Design Calculations of cycles already performed, according to a calculation scheme set up in the Reactor Technology Division of the J.E.N. using some computer codes acquired from foreign sources and other ones developed in the J.E.N. (auth)

10484 (WCAP—8189-R) **Fracture mechanics evaluation of the Trino reactor vessel.** Mager, T.R.; Bamford, W.H.; Yanichko, S.E.

(Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Feb 1975. 59p. Westinghouse Electric Corp., Pittsburgh, PA.

Results are presented of the fracture toughness testing of the Trino pressure vessel, and the data are discussed in light of current US regulatory rules. This includes generation of heatup and cooldown curves based on the method of Appendix G of the Summer 1972 Addendum to Section III ASME Code. In addition, a fracture mechanics analysis was performed to demonstrate the integrity of the Trino reactor vessel. The analysis included a fatigue analysis utilizing fracture mechanics parameters, and the determination of critical flaw sizes for design (normal, upset, test) transients and a postulated accident (LOCA) condition. (auth)

10485 (WCAP—8647) **Analysis of fuel rod fretting wear.** Schmugar, K.L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). 1975. 25p. Westinghouse Electric Corp., Pittsburgh, PA.

A semiempirical method for calculating the fretting wear on a fuel rod due to flow-induced vibration is presented. The method utilizes fuel rod amplitude data from a hydraulic flow test along with the Archard theory. The method for determining the fuel rod amplitude, the use of the Archard wear equation and the parameters for the equation are described. A comparison of the calculated and experimentally measured wear is presented to show the validity of the method. (auth)

10486 EPRI-ASME program to study PWR secondary water chemistry. Martel, L.J. (Electric Power Research Inst., Palo Alto, CA); Pearl, W.L. *Proc. Am. Power Conf.;* **37**: 765-771(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

The Electric Power Research Institute, working with the Utility Subcommittee of the ASME, EEI Chemistry Subcommittee of the Prime Movers Committee, Corrosion Advisory Committee, and various utility companies, has made a major start to define a developing problem area of PWR steam generators and to initiate programs required for its solution. A systems approach is being taken to alleviate the problem for the short term and solve the problem in the long term. (auth)

10487 Quality-assurance problems at Midland nuclear power plant. McGlothlan, C.K. (Oak Ridge National Lab., TN). *Nucl. Saf.;* **17**: No. 1, 87-96(1976).

An article is presented which examines the show-cause order issued by the Director of Regulation of the Atomic Energy Commission (AEC) in 1973 and the actions taken by the AEC (now Nuclear Regulatory Commission), the owner, the architect—engineer, and others in identifying and resolving certain quality deficiencies that have occurred since 1970 in the design and construction phases of the Midland nuclear power plant. Improvements in the Midland Quality Assurance Program, which resulted in a ruling by the AEC Regulatory Staff in favor of the owner, are discussed. (auth)

10488 (JPRS—66768, pp 24-33) **Some computer-technological aspects of the simulation of a nuclear power plant with pressurized water reactor.** Szilagyi, B. (Budapest Technil University); Benedek, S.; Homoki, G. 11 Feb 1976. Translated from Meres Autom.; 34: No. 10, 375-378(1975.

In Translations on Eastern Europe.

The construction of analog and digital computer simulation models suitable for the dynamic study of the primary cycles of pressurized-water type nuclear power plants is described. The model permits the study of normal operations, malfunction conditions, and stability matters. Solution of the mathematical model that characterizes the technological processes of the nuclear power plant is made difficult mainly by computer-technological factors. The analog model may also be used as a simulator in the training of operating personnel. (auth)

10489 Materials performance in operating pressurized water reactor steam generators. Weeks, J.R. (Brookhaven National Lab., Upton, NY). *Nucl. Technol.;* **28**: No. 3, 348-355(Mar 1976).

The Inconel-600 tubing in operating pressurized water reactor (PWR) steam generators has developed leaks due to intergranular stress corrosion cracking or a general wastage attack, originating from the secondary side of the tubing. Corrosion has been limited to those areas of the steam generators where limited secondary coolant circulation and high heat flux have caused impurities to concentrate. Wastage or pitting attack has always been associated with local concentrations of sodium hydrogen phosphates, whereas stress corrosion has been associated with local concentration of sodium or potassium hydroxides. The only instance of stress corrosion originating from the primary side occurred on cold-worked tubing when hydrogen was not added to getter oxygen, and LiOH was not added to raise the pH of the primary coolant. All U. S. PWR manufacturers are now recommending an all-volatile treatment of the secondary coolant, whereas many plants operated until recently using a phosphate treatment. Experience in operating plants has shown, however, that removal of phosphate-rich sludge deposits is difficult, and that further wastage and/or intergranular stress corrosion can develop; the residual sodium phosphates gradually convert by reaction with corrosion product hydroxides to sodium hydroxide, which remains concentrated in the limited flow areas. Improvements in circulation patterns have been achieved by inserting flow baffles in some PWR steam generators. Inservice monitoring by eddy current techniques, as recommended in U. S. Nuclear Regulatory Commission Regulatory Guide 1.83, is useful for detecting corrosion-induced defects in the tubing, but irreproducibility in field examinations can lead to uncertainties in interpreting the results. (auth)

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 10630, 10646, 10676, 10684, 10685, 10686, 10687, 10693, 10701, 10703

10490 (BNWL-CC—1401) **Corrosion evaluation of N reactor pressure tube 1756.** Larrick, A.P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 26 Oct 1967. 47p. (NSF/RA/N—74-118). Dep. NTIS $4.00.

Declassified 13 Jun 1973.

N Reactor Zircaloy-2 pressure tube No. 1756 and its associated ASTM A234 steel nozzles were examined for corrosion and hydrogen content after approximately 300 days exposure in-reactor. Visual examination showed tight, adherent, dull black oxides in the pressure tube except for scratching in the bottom due to sliding of fuel and fuel spacers through the tube during charge-discharge operations. Several fretted areas up to $^3/_8$ inch wide by $^1/_2$ inch long by up to 13 mils deep were observed at the downstream end—these pits were caused by vibration of the fuel spacers against the pressure tube. Hydrogen levels were fairly constant along the tube length with an average of about 19 +- 6 ppm except at one location. At approximately 30 inches from the front end of the tube a sharp peak to a maximum of 58 ppm hydrogen occurred. The reason for the peak is unknown. (auth)

10491 (BNWL-CC—2101) **Corrosion evaluation of N reactor pressure tube 2455.** Larrick, A.P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1969. 55p. Dep. NTIS $4.50.

Declassified May 1973.

N Reactor Zircaloy-2 pressure tube No. 2455 and its associated ASTM A234 steel nozzles were examined for corrosion and hydrogen content after approximately 680 days exposure in-reactor above zero power. The data are compared with data from a previous tube removed after approximately 300 days exposure. A visual examination of the ID and OD surfaces indicated adherent, dull black oxides on the pressure tube except for regions in the bottom third of the tube ID where numerous shallow (0.5 mil) scratches were found. These were due to sliding of fuel and fuel spacers through the tube during charge-discharge operations. Accelerated corrosion was not occurring at the scratched areas. Galling was observed at the location near the downstream end of the tube where a fuel rupture occurred; the galling was probably due to either the rupture or the rupture removal operation. Fretting corrosion of the tube at areas of contact between the pressure tube and the downstream spacers appeared to be similar to the fretting corrosion found in the previous tube. (auth)

10492 (CONF-750758—(Summ.), pp 73-88) **Small gas-cooled pebble-bed reactor.** Kakretz, A.E.; Woike, O.G. (General Electric Co., Fairfield, CT). Oct 1975.

From Meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America [USA] (31 Jul 1975).

In Summaries of papers presented at the meeting on small nuclear reactors for industrial energy.

The conceptual design of a 500 MW(t) pebble bed reactor for production of hydrogen and/or steam is described. (JWR)

10493 (CONF-750758—(Summ.), pp 95-105) **Small commercial size HTGR for industrial energy applications.** McMain, A.T. (General Atomic, San Diego, CA). Oct 1975.

From Meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America [USA] (31 Jul 1975).

In Summaries of papers presented at the meeting on small nuclear reactors for industrial energy.

An evaluation of the use of 2000—3000 MW(t) HTGR's for industrial process heat is presented. The flexibility of the

HTGR design for a wide range of industrial needs is indicated. (JWR)

10494 (EUR—5395(Vol.2), pp 633-639) **Temperature measurement with thermocouples at high temperature gas-cooled reactors.** Kaiser, G.E. (H.R.B., Mannheim, Ger.). 1975.

From International colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In International colloquium on high-temperature in-pile thermometry.

Instrumentation is described for temperature measurement systems for the THTR-300 reactor and for HTGR type reactors. The systems measure temperatures at the steam generator and circulator inlets and at the outlet of the core region. (DG)

10495 (GA-A—13267) **Postirradiation examination of capsules HRB-4, HRB-5, and HRB-6.** Scott, C.B.; Harmon, D.P. (General Atomic Co., San Diego, Calif. (USA)). 28 Nov 1975. Contract E(04-3)-167. 132p. Dep. NTIS $5.45.

A description is given of an experiment to evaluate the irradiation performance of fuel rods fabricated using candidate processes and materials for the large high-temperature gas-cooled reactor (LHTGR) start-up and recycle fuel systems. The GA fuel specimens tested in each capsule consisted of six bonded fuel rods fabricated on prototype production equipment with preproduction candidate matrix and graphite shim materials. The fuel rods were fabricated by the admix-compaction and hot-injection processes and were carbonized in graphite tubes to simulate the in-block curing process envisioned for LHTGR fuel fabrication. The irradiation tests were conducted in the removable beryllium facility of the ORNL High-Flux Isotope Reactor (HFIR), and the capsules were monitored for in-pile fission gas release. The post-irradiation integrity of the 18 fuel rods tested was excellent. Irradiation-induced fuel rod dimensional changes were compatible with the dimensional change behavior of LHTGR near-isotropic moderator graphite. Fertile particle coating failure was attributed to excessive internal gas pressures generated during irradiation to those severe conditions, although matrix/coating interaction was a contributing failure mode. Fissile particles exhibited outer pyrocarbon (OPyC) coating failure levels up to 72.6 percent. High OPyC coating failure levels were attributed to excessive matrix/coating interactions resulting from the surface porosity of the OPyC coatings and the high matrix coke weight to fuel rod surface area ratios. As a result of these and other tests, LHTGR-type fuel rod matrix compositions with low coke weight to fuel rod surface area ratios have been developed to eliminate matrix/coating interactions. These matrix compositions are being tested in subsequent capsule irradiation tests.

10496 (GA-A—13422) **Public Service Company of Colorado 330-MW(e) High-Temperature Gas-Cooled Reactor research and development program. Quarterly progress report for the period ending March 31, 1975.** (General Atomic Co., San Diego, Calif. (USA)). 30 Apr 1975. Contract AT(04-3)-633. 19p. Dep. NTIS $4.00.

The continuation of the research and development program for the Public Service Company of Colorado 330-MW(e) High-Temperature Gas-cooled Reactor is described. The work reported includes nuclear analysis of the fuel cycle, fuel zoning, and power shaping. Experimental procedures and results are discussed. (auth)

10497 (GA-A—13556) **Final report on graphite irradiation test OG-2.** Price, R.J.; Beavan, L.A. (General Atomic Co., San Diego, Calif. (USA)). 15 Dec 1975. Contract E(04-3)-167. vp. Dep. NTIS $5.45.

Results are presented of dimensional, thermal expansivity, thermal conductivity, Young's modulus, and tensile strength measurements on specimens of nuclear graphites irradiated in capsule OG-2. About half the irradiation space was allocated to H-451 near-isotropic petroleum-coke-based graphite or its subsized prototype grade H-429. Most of these specimens had been previously irradiated. Virgin specimens of another near-isotropic graphite, grade TS-1240, were irradiated. Some previously irradiated specimens of needle-coke-based H-327 graphite and pitch-coke-based P_3JHAN were also included.

10498 (GA-A—13737) **HTGR fuels and core development program. Quarterly progress report for the period ending November 30, 1975.** (General Atomic Co., San Diego, Calif. (USA)). 31 Dec 1975. Contract E(04-3)-167. 248p. Dep. NTIS $7.60.

The work reported includes studies of reactions between core materials and coolant impurities, basic fission product transport mechanisms, core graphite development and testing, the development and testing of recyclable fuel systems, and physics and fuel management studies. Materials studies include irradiation capsule tests of both fuel and graphite. Experimental procedures and results are discussed and the data are presented in tables, graphs, and photographs. (auth)

10499 (GA-A—13778) **Component and systems development program. Quarterly progress report for the period ending December 31, 1975.** (General Atomic Co., San Diego, Calif. (USA)). 31 Jan 1976. Contract E(04-3)-167. vp. Dep. NTIS $5.45.

The objectives of the program reported are to provide a data base for the properties of materials used in the non-core construction of important components of the HTGR; to demonstrate the adequacy of the thermal barrier design in two critical areas: (1) fatigue life of attachment fixtures and (2) resiliency of insulation under vibration; and to investigate control and instrumentation systems associated with the safe operation of the HTGR. (auth)

10500 (GA-A—13793) **Fort St. Vrain Surveillance and Testing Program. Quarterly progress report for the period ending December 31, 1975.** (General Atomic Co., San Diego, Calif. (USA)). 31 Jan 1976. Contract E(04-3)-167. 5p. Dep. NTIS $4.00.

This publication continues the quarterly report series on Fort St. Vrain (FSV) Surveillance and Testing. The program will perform post-startup tests on FSV plant components and systems to increase our knowledge of operating characteristics of large HTGRs. (auth)

10501 (GA-A—13814) **Fort St. Vrain helium circulator auxiliary systems: dynamic performance evaluation and acceptance tests.** Rodriguez, C. (General Atomic Co., San Diego, Calif. (USA)). 22 Jan 1976. Contract E(04-3)-633. 34p. Dep. NTIS $4.00.

The purpose of the tests described is to show that the dynamic performance of the Fort St. Vrain helium circulator auxiliary systems satisfies all the guidelines and criteria established and agreed to by Public Service Company of Colorado (PSC), Proto-Power, and General Atomic Company (GA). Specifically, it is shown that transfers to and from backup bearing water and helium purification system transients do not cause any circulator trips. Furthermore, at PSC's request, in an effort to resolve any NFSC questions concerning these systems, the satisfactory repeatability of their dynamic performance is shown beyond any doubt.

10502 (GA-A—13823) **Fort St. Vrain dew point moisture monitor system post-modification test results (RT-355C).** Del Bene, J.V.; Roebuck, P.M.; Swanson, L.L. (General Atomic Co., San Diego, Calif. (USA)). 9 Feb 1976. Contract E(04-3)-633. vp. Dep. NTIS $5.45.

Test results and evaluations are presented which were obtained subsequent to the installation of dew point moisture monitor (DPMM) bypass valve actuators and sample flow controllers in the Fort St. Vrain HTGR. New sample loop filters were installed to obtain all test data for clean filter operation. Testing was accomplished by supplying primary coolant gas from the PCRV through the DPMM system to the reactor building ventilation system. This allows measurements to be taken independent of circulator operation. Evaluation of the results of the current tests indicates that the modified DPMM system performs satisfactorily and meets all response time criteria. Based on the data collected, an evaluation was made of the performance of the system with higher than usual sample loop resistance. Minimum sample flow rates and bypass valve positions that ensure acceptable response times are met were determined.

10503 (LA—6179-MS) **Beginning-of-life neutronic analysis of a 3000-MW(t) HTGR.** Vigil, J.C. (Los Alamos Scientific Lab., N.Mex. (USA)). Dec 1975. Contract W-7405-Eng-36. 47p. Dep. NTIS $4.00.

The results of a study of safety-related neutronic characteristics for the beginning-of-life core of a 3000-MW(t) High-Temperature Gas-Cooled Reactor are presented. Emphasis was placed on the temperature-dependent reactivity effects of fuel, moderator, control poisons, and fission products. Other neutronic characteristics studied were gross and local power distributions, neutron kinetics parameters, control rod and other material worths and worth distributions, and the reactivity worth of a selected hypothetical perturbation in the core configuration. The study was performed for the most part using discrete-ordinates transport theory codes and neutron cross sections that were interpolated from a four-parameter nine-group library supplied by the HTGR vendor. A few comparison calculations were also performed using nine-group data generated with an independent cross-section processing code system. Results from the study generally agree well with results reported by the HTGR vendor. (auth)

10504 (ORNL/TM—5206) **Inelastic analysis of two plates under deformation dependent loads.** Iskander, S.K.; Collins, C.W.; Sanders, J.P. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 24p. Dep. NTIS $5.00.

Cover plates are used in current designs for high temperature gas-cooled reactors to compress the mineral fiber insulation against the inside of the liner of the prestressed concrete pressure vessel. In the upper plenum, these plates are hexagonal and specified as carbon steel; in the lower cross ducts, the plates are square and made of Hastelloy X. The General Atomic Company has specified both damage and safety limit criteria for these plates. These plates have been analyzed at these limits using the inelastic finite element computer program EPACA. The results indicate that the total strains for the square plate were within the specified values; however, the maximum deformations at the free corners indicate separation from the insulation and failure to achieve one of the design requirements. Since no material data were available for carbon steel at the limiting temperatures, it was assumed that the hexagonal plates were constructed of $2^1/_4$ percent Cr—1 percent Mo material. Although this material was found to produce satisfactory performance, extrapolation of available information would lead to the conclusion that the performance of carbon steel plates would not be satisfactory at the specified conditions. (auth)

10505 Preoperational chemical cleaning of Fort St. Vrain Nuclear Generating Station systems. Tatum, C.B. (Ebasco Service Inc., New York); Schuetzenduebel, W.G.; Riebe, J.J.; Eisenhofer, J.J. *Proc. Am. Power Conf.*; **37**: 772-780(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

The Fort St. Vrain Chemical Cleaning Operation presented significant challenges because of various plant design features, the advanced status of preoperational testing, and the high level of results required. Intensive preplanning, careful administrative controls, and the cooperation of each of the several organizations involved combined to meet this challenge in less than scheduled time, in compliance with all cleaning specification criteria, and without damage to plant operating systems. (auth)

10506 Nuclear reactor. Tilliette, Z. (to Commissariat a l'Energie Atomique). US Patent 3,909,351. 30 Sep 1975. Priority date 2 May 1973, France. 10p.

A description is given of a nuclear reactor and especially a high-temperature reactor in which provision is made within a pressure vessel for a main cavity containing the reactor core and a series of vertical cylindrical pods arranged in spaced relation around the main cavity and each adapted to communicate with the cavity through two collector ducts or headers for the primary fluid which flows downwards through the reactor core. Each pod contains two superposed steam-generator and circulator sets disposed in substantially symmetrical relation on each side of the hot primary-fluid header which conveys the primary fluid from the reactor cavity to the pod, the circulators of both sets being mounted respectively at the bottom and top ends of the pod. (Official Gazette)

10507 Computer simulation of pulsed-neutron experiments performed on the Fort St. Vrain high-temperature gas-cooled reactor. Pfeiffer, W. (General Atomic, San Diego, CA). *Nucl. Technol.*; **27**: No. 3, 337-351(Nov 1975).

Computer simulations were used to determine the optimum source location, detector location, and pulse rate prior to performing pulsed-neutron experiments on the 330-MW Fort St. Vrain high-temperature gas-cooled reactor (HTGR). The simulation procedure involved calculation of the amplitudes, decay constants, and modal shapes of the first few kinetic modes in the general expansion of the time response of the neutron flux following each pulse. The kinetic modes were calculated by the eigenfunction expansion method in two-dimensional geometry assuming two energy groups and six delayed-neutron precursors. The major limitation in the calculation is the use of two-dimensional core models, i.e., the assumption of separation of variables. For most power reactors on which pulsed-neutron experiments might be performed, this limitation should not be serious. (auth)

10508 Refabrication technology for HTGR fuels. Sease, J.D. (Oak Ridge National Lab, TN); Zimmer, E.; Bradley, R.A. *Trans. Am. Nucl. Soc.*; **22**: 336-337(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10509 High-temperature gas-cooled reactor steam generator design. Schuetzendeubel, W.G. (General Atomic Co., San Diego, CA). *Nucl. Technol.*; **28**: No. 3, 315-327(Mar 1976).

A prestressed concrete reactor vessel (PCRV) was used in the design of the 330-MW(e) Fort St. Vrain power demonstration plant. Use of the PCRV made the integration of all the nuclear steam supply system components practical. The primary coolant inventory was reduced and external piping and steam generator pressure shells were eliminated. A once-through-type steam generator system was selected. Materials selected for use in the pressure parts exceeded American Society of Mechanical Engineers Code requirements. The next step in the development of HTGR technology is the large commercial HTGR plant, which has once-through-type steam generators with a nominal capacity of 500 MW(th). Materials used in the main steam section range from $2^1/_4$ Cr—1 Mo to Ni—Fe—Cr (Alloy 800). High carbon levels were used to increase the creep strength of the materials. Gas cooling for fast breeder reactors is being studied by designing a 300-MW(e) demonstration plant. The steam generators are similar to the design of the Fort St. Vrain and large commercial plants. Tubes made of Alloy 800 are used. (auth)

10510 N reactor steam generator performance. Carlson, P.A.; Kratzer, W.K. (United Nuclear Industries, Richland, WA). *Nucl. Technol.*; **28**: No. 3, 383-387(Mar 1976).

The N Reactor is equipped with 12 horizontal U-tube steam generators. Originally, these contained Type 304 stainless-steel tubes. From 1964 through 1971, ten were retubed with Inconel-600 tubes because severe stress corrosion cracking was experienced in stainless-steel tubes. Tube performance is monitored by eddy-current examinations, tube removals for destructive examination, and checking for radioactivity in the secondary system. The results of this program show that no significant corrosion has occurred in the Inconel-600 tubes in 11 yr of service. Five tube leaks have occurred in the two remaining units with Type 304 stainless-steel tubes over the same period. (auth)

10511 Effects of service environments on the behavior of high-temperature gas-cooled reactor steam generator structural materials. Mazandarany, F.N. (General Atomic Co., San Diego, CA); Rittenhouse, P.L. *Nucl. Technol.*; **28**: No. 3, 406-423(Mar 1976).

The literature pertinent to the steam and water corrosion of high-temperature gas-cooled reactor (HTGR) steam generator materials was reviewed and used to corroborate the expected excellent performance of Incoloy 800 and $2^1/_4$ Cr—1 Mo steel. Similarly, available information on HTGR primary coolant-metal compatibility (helium corrosion) was assessed in relation to results obtained in ongoing programs. Quantitative results from these programs were interpreted in terms of a qualitative mechanistic model. (auth)

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

10512 (AECL—5117) **Nuclear power for district heating.** Lyon, R.B.; Sochaski, R.O. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1975. 70p. Dep. NTIS (US Sales Only) $4.50. AECL $1.50.

Current district heating trends are towards an increasing use of electricity. The evaluation of an alternative means of energy supply, the direct use of thermal energy from CANDU nuclear stations, is described. The energy would be transmitted via a hot fluid in a pipeline over distances of up to 40 km. Advantages of this approach include a high utilization of primary energy, with a consequent reduction in installed capacity, and load flattening due to inherent energy storage capacity and transport delays. Disadvantages include the low load factors for district heating, the high cost of the distribution systems and the necessity for large-scale operation for economic viability. This requirement for large-scale operation from the beginning could cause difficulty in the implementation of the first system. Various approaches have been analyzed and costed for a specific application—the supply of energy to a district heating load centre in Toronto from the location of the Pickering reactor station about 40 km away. (auth)

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 10316, 10602, 10675, 10677, 10682, 10690, 10691, 10692, 10694, 10706, 10707, 10723, 10724, 10725, 10726, 10727, 10728, 10729, 10730, 10731, 10732, 10733, 10734, 10735, 10736, 10737, 10738, 10739, 10740, 10741, 10742, 10743, 10744, 10745, 10746, 10747, 10748, 10749, 10751, 10999, 11002, 11003, 11004, 11014, 11055, 11396, 11913

10513 (ANL—8112) **THI3D: a computer program for steady-state thermal-hydraulic multichannel analysis.** Sha, W.T.; Schmitt, R.C. (Argonne National Lab., Ill. (USA)). Dec 1975. Contract W-31-109-Eng-38. 119p. AT.

A new computational model for steady-state, single-phase, thermal-hydraulic multichannel analysis is presented. The model

accounts for conservation of mass, energy, and momentum subject to pressuregdrop boundary conditions and leads to a nonlinear multipoint boundary-value problem. Turbulent interchange, radial thermal conduction, and forced flow due to the wire wrap or grid between channels are explicitly taken into account. Temperature distributions in the coolant, cladding, fuel, and duct wall and the size of the central void of the oxide fuel after thermal restructuring are computed. Three different thermal-hydraulic channel arrangements (square, hexagonal, and triangular) can be treated by the method presented here. Multipin analysis with transverse interactions, or multiassembly calculations without transverse interactions between the channels, can be performed. The most important feature of the model is that problems in partial flow blockage can be analyzed, and the effect on the redistribution of the inlet mass velocity can be taken into account. (auth)

10514 (ANL-CT—75-23) **Study on the nodal approximation of the CRBR core simulation.** Saphier, D.; Kirsch, L.W.; Mulcahey, T.P. (Argonne National Lab., Ill. (USA)). Jan 1975. Contract W-31-109-Eng-38. 31p. AT.

The WARD Rev model for simulating the CRBR core has been revised. Errors have been corrected and the nodal approximation expanded to include up to 25 instead of the fixed 5 nodes in the WARD model. A detailed description of the upper axial blanket—10 axial and 4 radial nodes—instead of the lumped parameter model, has also been inserted in the new program. The simulation has been used to obtain detailed transient temperature distribution initiated by a pump trip and followed in 2.2 sec by a power trip. Comparative calculations with 25 and 5 nodes gave essentially the same result for the hot spot temperature and the hot spot location. It was concluded that the nodal approximation used by WARD for the present WARD model is sufficient to describe the transient of the hot spot temperature and its location.

10515 (ANL-CT—76-21) **Acoustic detection of the collapse of a sodium vapor bubble in an infinite sea of sodium.** Carey, W.M. (Argonne National Lab., Ill. (USA)). Dec 1975. 50p. Dep. NTIS $4.00.

A discussion of the problem of sodium vapor bubble collapse is presented. The physics of vapor collapse is presented in light of the work by Peppler et al. Theoretical estimates of the sound source level based on the work by Rayleigh and Judd are compared to an approximate pressure-volume work approach and recent experimental observations. Reactor ambient noise and transmission loss considerations are presented in regard to their impact on this detection problem. A methodology is proposed which considers the importance of the sound source level, ambient noise, transmission loss and a detection threshold and provides a means by which the feasibility of sodium vapor bubble collapse detection in an operating LMFBR may be assessed. The interrelationships between the detection threshold and the probability of detection and false alarm are discussed and applied to a standard acoustic square law detection system. This analysis clearly illustrates that the feasibility of such a detection system is strongly dependent on the knowledge of sound source levels, ambient noise levels and the transmission loss between the source and receiver. Furthermore, requirements of a high degree of probability of detection and a low probability of false alarm were found to require a high signal to noise ratio for a single sensor system but that the probability of false alarm requirement could be relaxed for systems multiple independent sensors. Finally, the need for additional experimental and theoretical information is presented in terms of sound source levels, ambient noise and a means for determining transmission loss. (auth)

10516 (ANL-CT—76-26) **Flow-induced vibration scale model test of the CRBR instrument post.** Mulcahy, T.M.; Yeh, T.T.; Lawrence, W. (Argonne National Lab., Ill. (USA)). Feb 1976. 35p. AT.

A one-third scale model of the CRBR Instrument Post was designed, fabricated, and bench tested to determine whether impinging flow from fuel assembly exit nozzles would induce significant vibrations. Distortions made in scaling are discussed. Typical reactor operating conditions were included in the rest parameters: flow rates, flow distributions, and vertical gaps, lateral misalignments, and rotational misalignments between the bottom of the I/P and the top of the fuel assembly nozzle. Shaker testing showed the lowest bending and torsional frequencies had been simulated with less than 2 percent damping, and the model had been isolated from test system frequencies. Flow testing indicated the response of the I/P model was due to random pressure fluctuations, with no fluid elastic excitation occurring. While variations in the response with different test parameters did occur, in general, the response was very small.

10517 (CONF-750117—P2, pp 1173-1189) **U.S. Liquid Metal Fast Breeder Reactor program.** Nemzek, T.A. 1975.

From International symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In International symposium on nuclear power technology and economics. Volume II.

The reasons for having the LMFBR program are briefly discussed. The objectives of the program are discussed and the various subtasks involved in meeting the objectives are reviewed. Fuels and materials development, safety research, and components development are described. (JWR)

10518 (CONF-760314—1) **Studies in nondestructive testing with potential for in-service inspection of LMFBRs.** McClung, R.W. (Oak Ridge National Lab., Tenn. (USA)). 1976. 13p. Dep. NTIS $3.50.

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

A variety of nondestructive examination techniques have been and are being developed at ORNL with potential for ISI in LMFBRs. Among these are radiographic techniques for radiation environment and image enhancement, advanced eddy-current techniques and equipment for flaw detection and thickness measurement and ISI of steam generator tubing, and ultrasonic methods for quantitative flaw evaluation using frequency-analysis and bore-side ultrasonic techniques for steam generator tubing. Further developments should result in positive application to ISI.

10519 (ERDA—68) **Liquid Metal Fast Breeder Reactor Program (LMFBR): facility profiles.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Research and Development; Argonne National Lab., Ill. (USA)). Dec 1975. 288p. Dep. NTIS $9.25.

A description is presented of the experimental test facilities involved in the conduct of the LMFBR research and development program. Existing facilities and those under construction or authorized as of October 1975 are described. Each profile presents brief descriptions of the overall facility and its test area and data relating to its experimental and testing capability. Introductory material for each section includes site and facility maps and an alphabetical list of the profiles contained in the section. A glossary of acronyms and letter designations in common usage to describe organizations, reactor and test facilities, components, etc. involved in the LMFBR program is included. Alphabetical, organizational, and programmatic indexes are provided as a convenient method of identifying the facilities with their locations and with their principal uses in the LMFBR program.

10520 (EUR—5395(Vol.1), pp 413-428j) **Environmental and long-time tests on thermocouples for measuring the fuel-output-temperature in the SNR 300.** Hans, R.; Knaak, J. (INTERATOM, Bensberg, Ger.). 1975.

From International colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In International colloquium on high-temperature in-pile thermometry.

Chromel/Alumel thermocouples sheathed with 304L stainless steel and insulated with MgO are integrated to fuel element probes to indicate sodium temperature at the outlets of the fuel channels of the SNR 300. Tests on incorporated thermocouples are reported in this paper. After more than 5000 hours of long term testing at 680 K mean temperature none of 196 thermocouples failed. (auth)

10521 (GA-A—13766) **Gas-Cooled Fast Breeder Reactor. Quarterly progress report, August 1, 1975—October 31, 1975.** (General Atomic Co., San Diego, Calif. (USA)). 5 Jan 1976. Contract E(04-3)-167. 196p. Dep. NTIS $7.60.

The tasks of the Gas-Cooled Fast Breeder Reactor (GCFR) program that are supported by the U. S. Energy Research and Development Administration include: development of GCFR fuel, blanket, and control elements; development of the pressure equilization system for GCFR fuel; an out-of-pile loop facility test program plan; fuels and materials development; fuel-, blanket- and control-rod analyses and development; nuclear analysis and reactor physics for GCFR core design; shielding requirements for the GCFR; reactor engineering to assess the thermal, hydraulic and structural performance of the core and core support structure; development of reactor components including the reactor vessel, control and locking mechanisms, fuel-handling equipment, core support structure, shielding assemblies, main helium circulator, steam generator, and auxiliary circulator; the development of a helium circulator test facility; and reactor safety, including an in-pile safety evaluation program. (auth)

10522 (GEAP—10028-56) **Core engineering. Fifty-sixth quarterly report, August—October 1975.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Nov 1975. Contract E(04-3)-893. 33p. AT.

The objective of the work reported is to provide the engineering design basis for the core of a liquid metal cooled fast breeder reactor. Progress is described for tasks related to Grid Spaced Driver Assembly, Wire-Wrap Assembly Engineering, Core Component, Structural Design Criteria, and Probabilistic Design. (auth)

10523 (HEDL-SA—929A) **Recent developments in the analysis of coolant sodium for fast breeder reactors.** Keough, R.F.; McCown, J.J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1976. 21p. (CONF-750806—6). Dep. NTIS $3.50.

From 170. American Chemical Society national meeting; Chicago, Illinois, USA (24 Aug 1975).

The measurement of impurities in sodium is an important part of the sodium technology for the fast breeder reactor program. A knowledge of impurity levels in sodium provides an important source of information on such things as corrosion rates, air and water leak location and detection, and the effectiveness of the sodium purification systems. A discussion is presented of some of the analytical techniques for sodium characterization in reactor heat transfer systems. Emphasis is placed on some recently developed alternatives to laboratory analysis.

10524 (HEDL-TC—327) **Water vapor nitrogen process for sodium removal.** (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1975. Contract E(45-1)-2170. 109p. AT.

The objective of this document is to present the data, information and conclusions resulting from the Water Vapor Nitrogen Process development program and to provide a basis for sodium removal process selection for LMFBR facilities. The report focuses on information needed to evaluate the technical acceptability of the process, omitting issues of economics, safety, licensability, and compatibility with other plant systems. To accomplish this, the report discusses: (1) characteristics of the Water Vapor Nitrogen Process (WVN), (2) possible conditions for stress corrosion cracking related to the process, (3) process control parameters and implementation, and (4) applicable process scale-up experience. (auth)

10525 (HEDL-TME—75-12) **Compilation of data and descriptions for United States and foreign liquid metal fast breeder reactors.** Appleby, E.R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1975. Contract AT(45-1)-2170. vp. Dep. NTIS $13.60.

This document is a compilation of design and engineering information pertaining to liquid metal cooled fast breeder reactors which have operated, are operating, or are currently under construction, in the United States and abroad. All data has been taken from publicly available documents, journals, and books. (auth)

10526 (LMEC-TDR—75-13) **Testing of the Kaman prototype level transducer.** Fischer, B.E. (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 1975. Contract E(04-3)-700. 45p. AT.

Results are described of the test program conducted at the Liquid Metal Engineering Center (LMEC) to determine the performance of a prototype level measuring system supplied by Kaman Sciences Corporation. Sodium testing included calibrations from 300 to 1200°F. The test program was conducted over a period of approximately two months.

10527 (ORNL—5078) **Molten-salt reactor program. Semiannual progress report for period ending August 31, 1975.** McNeese, L.E. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 170p. Dep. NTIS $8.50.

Separate abstracts were prepared for sections on MSBR design and development, chemistry, materials development, fuel reprocessing, and salt production. (JWR)

10528 (ORNL—5078, pp 1-27) **MSBR design and development.** Engel, J.R. Feb 1976.

In Molten-salt reactor program. Semiannual progress report for period ending August 31, 1975.

Progress in MSBR design and development is reported under the following headings: tritium behavior, xenon behavior, neutronic analysis, high-temperature design methods, gas-systems technology facility, coolant-salt technology facility, and forced convection loops. (JWR)

10529 (ORNL—5101) **Neutron Physics Division progress report for period ending October 31, 1975.** Maienschein, F.C. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 122p. Dep. NTIS $7.00.

Included are 127 abstracts and summaries of papers and reports published or presented at scientific meetings during the reporting period, which extends from August 31, 1974 to October 31, 1975. The primary areas of study are the liquid-metal fast breeder reactor program, the gas cooled fast breeder reactor program, the controlled thermonuclear reactor program, the high-energy accelerator shielding program, and the defense nuclear agency program. (BJG)

10530 (WARD-SG—3045-1(Vol.1)) **Alternate steam generator development program. Phase I summary report, September 1974—December 1974. Volume 1. Development of alternate steam generators for LMFBR plants.** Adkins, C.R.; Mangus, J.D.; Gross, M.C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Oct 1975. Contract E(11-1)-3045. 218p. AT.

The overall purpose of the program described is the development of a steam generator and associated systems which possess the reliability to be used directly in the primary sodium system of an LMFBR. The program schedule has been established to provide a full-size steam generator model for testing in, or as a back-up for, the secondary steam generation system in the CRBR plant. The purpose of Phase I of the program has been to explore the capabilities and limitations of potential, alternate steam generators. The specific concepts that have been covered in this phase are: (a) general fluidized bed concepts, i.e., gaseous heat transfer media with solid suspensions, (b) static bed concepts, using a solid heat transfer medium, (c) alternate intermediary heat transfer fluids. A status report on items (a) and (b) is included. (auth)

10531 (ANL-Trans—1046) **Calculations by Monte-Carlo method in three dimensions (TRIPOLI code) of neutron spectrum in the lower shields of the Phenix.** Nimal, J.C.; Vergnaud, T. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Oct 1970. Translation of CEA-N—1359. 38p. Dep. NTIS $4.00.

The results of computations done with the help of the TRIPOLI code for the lower part of the Phenix reactor are presented. These computations are a preliminary step in the calculation trying to determine the activation of the secondary sodium. The case treated is in two dimensions and includes strong attenuation of the neutron flux. The results are compared with computations done in spherical geometry with the help of the NIOBE code.

10532 (ANL-Trans—1047) **Breakthrough of fast breeder reactors in France.** Denielou, G. Translated from *Rev. Fr. Electr.*; **45**: No. 238, 10-17(1972). 14p. Dep. NTIS $3.50.

The development of the French fast breeder reactor program is reviewed. (JWR)

10533 **Fast-neutron reactor.** Iljunin, V.G.; Murogov, V.M.; Shmelev, A.N. US Patent 3,912,583. 14 Oct 1974. Filed date 30 Aug 1973. 12p.

A description is given of a fast-neutron reactor wherein the core and the surrounding lateral and axial blankets are made up of fuel element stacks. The walls of each stack have holes in the middle portion thereof with respect to the height of the core. Main and additional fuel elements are arranged respectively above and below the plane passing through the centers ofthe holes, inside each stack, the spacing between which fuel elements form, together with the holes, the inlet header of the coolant washing the fuel elements. The inlet header splits the coolant into two oppositely directed flows lead away by two outlet headers arranged above and below the upper and lower axial blankets. (Official Gazette)

10534 **Overview of the Clinch River Breeder Reactor Plant project.** Van Nort, P.S.; Copeland, R.L. (Project Management Corp., Chicago). *Proc. Am. Power Conf.*; **37**: 213-220(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

Project status is briefly reported, and a design summary is presented. (DG)

10535 (ANL-Trans—1033) **Oxygen determination in liquid sodium with a continuous electrochemical measuring probe.** Jung, J. Translated from *J. Nucl. Mater.*; **56**: 213-220(1975). 13p. Dep. NTIS $3.50.

In order to measure continuously the oxygen content of sodium, a measuring probe was developed; it operates with the aid of ThO_2—Y_2O_3 solid electrolyte and a reference gas electrode. The probe consists of a solid electrolyte crucible, connected by a vacuum-tight soldered joint to a metal tube. Experiments with oxygen-saturated sodium, using reference gases with varying partial pressures of oxygen, showed that almost reversible emf's are attainable; the free standard enthalpy of formation thus determined, ΔG^0/sub Na_2O/, agrees well with published values. The calibration of a probe in a sodium loop revealed a linear relationship between the measured emf and the inverse cold-trap temperature, but deviations from reversible cell behavior were observed. 16 references. (auth)

10536 Liquid metal pump for nuclear reactors. Allen, H.G.; Maloney, J.R. (to U.S. Energy Research and Development Administration). US Patent 3,910,714. 7 Oct 1975. Filed date 11 Dec 1974. 4p.

PAT-APPL-531,589.

A pump for use in pumping high temperature liquids at high pressures, particularly liquid metals used to cool nuclear reactors is described. It is of the type in which the rotor is submerged in a sump but is fed by an inlet duct which bypasses the sump. A chamber, kept full of fluid, surrounds the pump casing into which fluid is bled from the pump discharge and from which fluid is fed to the rotor bearings and hence to the sump. This equalizes pressure inside and outside the pump casing and reduces or eliminates the thermal shock to the bearings and sump tank.

10537 LMFBR with booster pump in pumping loop. Rubinstein, H.J. (to U.S. Energy Research and Development Administration). US Patent 3,912,584. 14 Oct 1975. Filed date 9 Jan 1974. 6p.

PAT-APPL-432,007.

A loop coolant circulation system is described for a liquid metal fast breeder reactor (LMFBR) utilizing a low head, high specific speed booster pump in the hot leg of the coolant loop with the main pump located in the cold leg of the loop, thereby providing the advantages of operating the main pump in the hot leg with the reliability of cold leg pump operation.

10538 Device for acoustic detection in a nuclear reactor. Hanff, M.; Lions, N.; Peronnet, J. (to Commissariat a l'Energie Atomique). US Patent 3,913,407. 21 Oct 1975. Priority date 22 Jul 1971, France. 6p.

A description is given of a device which comprises a first acoustic conductor placed vertically within the coolant liquid contained in a nuclear reactor vessel and a second coaxial acoustic conductor extending to the exterior of the reactor vessel. The device essentially comprises an accelerometer assembly for detecting signals delivered by the second conductor and an amplifier which applies the detected signals to measuring instruments located outside the reactor vessel. The accelerometer comprises an amplifying pressure needle carried by the upper end of the second conductor, a piezoelectric ceramic element, a block fitted with a spring for applying the ceramic element against the needle and a preamplifier connected in series with the amplifier. (Official Gazette)

10539 Transfer hood for handling fuel assemblies in nuclear reactors and especially fast reactors. Aubert, M.; Merland, D.; Renaux, C. (to Commissariat a l'Energie Atomique). US Patent 3,915,792. 28 Oct 1975. Priority date 8 Jun 1972, France. 8p.

A description is given of a hood for transferring fuel assemblies between two or more separate guide ramps inclined to the vertical at the same angle of slope and extending respectively through a first passage into the reactor vessel and through a second passage into a fuel-assembly storage chamber. The hood comprises at least one shielded duct joined to a flanged rotating portion which is so arranged that the open lower end of the shielded duct is positioned in the line of extension of one guide ramp and then the other as a result of displacement of the rotating portion. (Official Gazette)

10540 Mechanical properties of unirradiated fast reactor cladding during simulated overpower transients. Hunter, C.W.; Fish, R.L.; Holmes, J.J. (Westinghouse Hanford Co., Richland, WA). *Nucl. Technol.*; **27**: No. 3, 376-388(Nov 1975).

Internally pressurized specimens of unirradiated 20 percent cold-worked Type 316 stainless-steel cladding were rapidly heated and burst to determine mechanical behavior under various simulated reactor transient events. The tests were conducted at heating rates of 10 and 200 F°/sec. Failure temperatures from 500 to 2500°F were obtained, with the principal emphasis on the behavior above 1000°F. The observed increase in ductility with increasing temperature was due to recovery and recrystallization of the cold-worked material, while the ductility decrease above 2100°F resulted from grain growth. The diametral failure strains were between 0.5 to 1.0 percent at 1000°F. The maximum diametral failure strain values reached 8 percent for the 10°F/sec ramp and 4 percent for the 200°F/sec ramp at the elevated temperatures. (auth)

10541 Assessment of the coolant voiding dynamics following the failure of preirradiated LMFBR fuel pins. Cronenberg, A.W. (Univ. of New Mexico, Albuquerque); Grolmes, M.A. *Nucl. Technol.*; **27**: No. 3, 394-410(Nov 1975).

The flow transient for preirradiated fuel elements, brought to failure in a flowing sodium environment, was analyzed in terms of fission-gas-induced voiding. The analytic approach was based on single-phase isothermal expansion of the fission-gas bubble, which was assumed to be ideal and to fill the coolant-channel cross section uniformly. Gas discharge through the cladding breach was calculated using either the equation for critical or for subcritical flow, depending on the pin-to-bubble pressure ratio. The coolant was considered incompressible. (auth)

10542 Apparatus to simulate in-reactor heating conditions in advanced fuels. Wrona, B.J.; Johanson, E.; Galvin, T.M. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 220(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10543 Fracture mechanics analysis of the EBR-II steam generator duplex tubing. Wu, T.S.; Chopra, P.S. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 225(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10544 Dissimilar-metal weld technology. Noland, R.A.; Stone, C.C.; Szymko, C.T.; Bump, T.R. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 226-227(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10545 Fuel failure by transient fission gas release and the H3, H4, and H5 tests. Majumdar, D. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.*; **22**: 232-233(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10546 Vapor pressures of UC and $(U_{0.8}Pu_{0.2})C$ at extremely high temperatures. Sheth, A.; Tetenbaum, M.; Leibowitz, L. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 233-234(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10547 Two-dimensional variational estimates of reactivity worths and mutual interactions of perturbations. Woodruff, W.L. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 248-249(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10548 Proposed structure and temperature model for advanced LMFBR fuel pellet. Yang, C.I.; Barthold, W.P. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 279-280(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10549 Process technology for the MSR ^{233}U—Th cycle. Hightower, J.R. Jr. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; **22**: 338-339(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10550 Heterogeneous neutron streaming effects in the Clinch River Breeder Reactor. Dunn, F.E. (Argonne National Lab., IL); Lell, R. *Trans. Am. Nucl. Soc.*; **22**: 373-374(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10551 Effect of edge configuration on peripheral flow in sodium-cooled 19-rod bundles with helical wire-wrap spacers. Wantland, J.L.; Fontana, M.H.; Gnadt, P.A.; Hanus, N.; MacPherson, R.E.; Smith, C.M. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; **22**: 398-399(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10552 Effects of entrained gas on the acoustic detection of sodium boiling in a simulated LMFBR fuel bundle. Leavell, W.H.; Sides, W.H. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; **22**: 399-400(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10553 Method of removing bulk sodium from metallic surfaces. Maffei, H.P.; Borisch, R.R. (to U.S. Energy Research and Development Administration). US Patent 3,918,961. 11 Nov 1975. Filed date 12 Dec 1974. 8p.
PAT-APPL-532,138.

A process of removing sodium from an article, particularly one made of stainless steel, by treating it with a mixture of water vapor and a gas which is inert to sodium is described. By selecting combinations of temperature and water vapor-to-gas ratio, the reaction temperature is controlled to prevent damage to the articles.

10554 Reactor vessel seal service fixture. Ritz, W.C. (to U.S. Energy Research and Development Administration). US Patent 3,922,748. 2 Dec 1975. Filed date 9 May 1974. 4p.
PAT-APPL-468,322.

An apparatus for the preparation of exposed sealing surfaces along the open rim of a nuclear reactor vessel comprised of a motorized mechanism for traveling along the rim and simultaneously brushing the exposed surfaces is described.

10555 Energy absorber for sodium-heated heat exchanger. Essebaggers, J. (to U.S. Energy Research and Development Administration). US Patent 3,924,675. 9 Dec 1975. Filed date 3 May 1973. 4p.
PAT-APPL-356,879.

A heat exchanger is described in which water-carrying tubes are heated by liquid sodium and in which the results of accidental contact between the water and the sodium caused by failure of one or more of the water tubes is minimized. An energy absorbing chamber contains a compressible gas and is connected to the body of flowing sodium by a channel so that, in the event of a sodium-water reaction, products of the reaction will partially fill the energy absorbing chamber to attenuate the rise in pressure within the heat exchanger.

10556 (RDT-E—4-5T(Rev.)(1-76)) Forced-circulation cold trap assembly for removal of sodium impurities. (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Development and Demonstration). Jan 1976. 22p. RSO.

A standard is presented to delineate the requirements for the design, materials, fabrication, examination, acceptance testing, and delivery of a cold trap assembly to remove impurities from liquid sodium by crystallization. (auth)

10557 Boundary-value thermal-hydraulic analysis of a reactor fuel rod bundle. Sha, W.T.; Schmitt, R.C.; Huebotter, P.R. (Argonne National Lab., IL). *Nucl. Sci. Eng.*; **59**: No. 2, 140-160(Feb 1976).

A new computational model for steady-state, single-phase, thermal-hydraulic, multichannel analysis of fluid flow through nuclear reactor fuel elements is presented. The model accounts for the conservation of mass, energy, and momentum subject to pressure-drop boundary conditions and leads to a nonlinear multipoint boundary-value problem. The turbulent interchange, radial thermal conduction, and forced flow due to the wire-wrap or grid between the channels are explicitly taken into account. The temperature distribution of the coolant, cladding, and fuel, and the size of the central void of the oxide fuel after thermal restructuring are computed in the model. Three different thermal-hydraulic channel arrangements, i.e., square, hexagonal, and triangular, can be treated by the method presented here. Multipin analysis with transverse interactions or multiassembly calculations without transverse interactions between the channels can be performed. The most important features of this new computational model are: (a) that the effect of axial flow area variation has been incorporated into the derivation of governing equations, (b) that the cross-flow approximation has been improved so that the assumption of constant transverse momentum flux in the direction under consideration is removed, and (c) that partial flow blockage occurring anywhere along the flow path can be analyzed, and the effect on the inlet mass velocity redistribution can be taken into account. (auth)

10558 Materials development for advanced reactors. Cunningham, G.W. (Energy Research and Development Administration, Washington, DC). *Nucl. Technol.*; **28**: No. 3, 301-304(Mar 1976).

Materials development is needed in advanced reactor programs to improve economy and safety of nuclear system components, to provide data for advanced design methods needed for the severe operating conditions, and to nondestructively inspect components under poor accessibility. Interaction between alloy development, stress analysis, and component and system design guides the program on structural materials for core and secondary systems, including steam generators. Various austenitic, ferritic, and high-nickel alloys are being developed for different components. (auth)

10559 Design of the Clinch River Breeder Reactor Plant steam generators. Whipple, J.C.; Spalaris, C.N. (General Electric Co., Sunnyvale, CA). *Nucl. Technol.*; **28**: No. 3, 305-314(Mar 1976).

Three steam generation systems are employed in the Clinch River Breeder Reactor Plant to produce electrical power for delivery to the Tennessee Valley Authority grid. Each steam generator system contains two parallel operating evaporators and one superheater. These vertical shell and tube heat exchangers are arranged in a hockey stick configuration and are identical in design except for inlet water orifice inserts added to the evaporators to ensure flow stability. Alloy $2^1/_4$ Cr—1 Mo was selected as the material of construction for the sodium-water boundary on the basis of its excellent resistance to water side stress corrosion and fabricability. Development programs are underway to confirm the ability of the steam generators to operate with departure from nucleate boiling, obtain necessary mechanical and physical properties for design, confirm corrosion and decarburization design allowances, and develop reliable fabrication and inservice inspection techniques. (auth)

10560 Fabrication and inspection development for Clinch River Breeder Reactor Plant steam generators. McClung, R.W. (Oak Ridge National Lab., TN); Slaughter, G.M.; Spalaris, C.N.; Lillie, A.F. *Nucl. Technol.*; **28**: No. 3, 374-382(Mar 1976).

The Clinch River Breeder Reactor Plant steam generator that transfers the heat from the sodium system to the high-pressure system must maintain integrity and separation of the two fluids. The construction material used for the tubing and tubesheet is high-purity $2^1/_4$ Cr—1 Mo alloy steel. To attain confidence in successful manufacturing of the evaporator and superheater modules, key development activities are under way (a) to procure high-quality wrought materials, (b) to assure proper assembly (with emphasis on welding), and (c) to assure that adequate nondestructive testing methods are available to examine the units. (auth)

10561 Clinch River Breeder Reactor environmental effects: general water-side corrosion. DeVan, J.H.; Griess, J.C. (Oak Ridge National Lab., TN). *Nucl. Technol.*; **28**: No. 3, 398-405(Mar 1976).

Studies are described of the general corrosion of $2^1/_4$ Cr—1 Mo steel in pure superheated steam, in impure superheated and saturated steam, and under nucleate boiling conditions. The test parameters were selected to provide information relevant to the use of this steel for the Clinch River Breeder Reactor superheaters and evaporators. The oxidation rate of $2^1/_4$ Cr—1 Mo steel in superheated steam was measured under heat transfer conditions at 510 to 540°C (950 to 1005°F), and was approximately $1^1/_2$ times that measured under isothermal conditions. Extensive general attack of stressed $2^1/_4$ Cr—1 Mo steel specimens occurred in cyclic tests in superheated and saturated steam with chloride and oxygen additions, although no cracking or localized attack was observed. Considerably less attack occurred under superheat conditions or in the absence of oxygen. Tests under nucleate boiling conditions were operated to evaluate crevice effects associated with porous films on heat transfer surfaces. Significant crevice corrosion was produced in water containing 10 ppm chloride; a heavier but more general attack occurred in treated cooling tower water. (auth)

10562 Compatibility of Fe—$2^1/_4$ wt % Cr—1 wt % Mo steel in a sodium environment. Natesan, K.; Chopra, O.K.; Kassner, T.F. (Argonne National Lab., IL). *Nucl. Technol.*; **28**: No. 3, 441-451(Mar 1976).

Kinetics of decarburization of Fe—$2^1/_4$ wt percent Cr—1 wt percent Mo steel in a sodium environment has been studied at temperatures between 480 and 650°C in the normalized and normalized-tempered conditions. Carbon concentration-distance profiles were obtained as a function of sodium exposure time and decarburization rate constants were evaluated. It was found that the heat treatment of the steel had no effect on the decarburization behavior at 650°C; however, at lower temperatures, the normalized steel was found to decarburize significantly faster than the steel in the normalized-tempered condition. Microstructural examinations of specimens exposed at 650°C revealed that M_6C was the stable carbide, and the transformation of $M_{23}C_6$ to M_6C was accelerated by the decarburization process. In specimens exposed at 480°C, the stable carbides were found to be M_7C_3, Fe_3C, and M_3C. The results also showed that the steel would decarburize to a certain carbon level that corresponds to a stable carbide structure at each temperature, and any additional decarburization will be controlled by the dissolution rate of the carbide phases in the ferrite matrix. (auth)

10563 Effects of ten years Experimental Breeder Reactor II service on $2^1/_4$ Cr—1Mo steel. Shields, J.A. Jr.; Longua, K.J. (Argonne National Lab., Idaho Falls, ID). *Nucl. Technol.*; **28**: No. 3, 471-481(Mar 1976).

A 5-ft segment of $2^1/_4$ Cr—1 Mo ferritic steel pipe has been removed from the Experimental Breeder Reactor II (EBR-II) steam for metallurgical evaluation after 90,000 h of service in the temperature range of 580 to 820°F. Optical metallography, instrumented impact testing, tensile testing, Auger electron spectroscopy, and scanning electron fractography have been performed to assess the capability of the material to perform its function in the future. Service in the EBR-II steam system has resulted in additional precipitation of fine uniformly dispersed carbides throughout the microstructure. As a result of these changes, room temperature yield and tensile strengths are reduced 23.3 and 4.5 percent, respectively. Excellent toughness is observed on the upper shelf of the Charpy V-notch impact energy curve. No evidence of embrittlement phenomena was observed. The results indicate that the $2^1/_4$ Cr—1 Mo steel employed in the EBR-II system has not suffered significant degradation in metallurgical properties and should perform well in the future. (auth)

10564 Mechanical and physical properties of $2^1/_4$ Cr—1 Mo steel in support of Clinch River Breeder Reactor Plant steam generator design. Brinkman, C.R.; Williams, R.K.; Klueh, R.L.; Hebble, T.L. (Oak Ridge National Lab., TN). *Nucl. Technol.;* **28**: No. 3, 490-505(Mar 1976).

Mechanical and physical property tests on annealed $2^1/_4$ Cr—1 Mo steel were conducted in an effort to define behavior in support of the design of the Clinch River Breeder Reactor Plant steam generator system. True-stress true-plastic strain tensile data between the 0.2 percent offset yield stress and the ultimate tensile strength for temperatures between 25 and 593°C and strain rates between 6.7×10^{-6} to 6.7×10^{-3}/sec were fit with an equation. Creep data were analyzed and an analytical expression formulated defining strain-time behavior for primary and secondary creep. Similarly, an expression was obtained defining the time to the onset of tertiary creep as a function of stress and temperature. Strain- and load-controlled fatigue data were analyzed and proposed. American Society of Mechanical Engineers (ASME) fatigue design curves were formulated for temperatures ranging from 25 to 593°C. Dynamic strain aging was found to lower the fatigue strength of this material at 371°C, and this was attributed to dynamic strain aging. Results of subcritical crack growth tests are also reported. Comparisons between thermal conductivity and diffusivity values and those found in the ASME Code indicated that the new values were significantly higher than those presently found in the Code. (auth)

10565 U. S. advanced materials development program for steam generators. Patriarca, P. (Oak Ridge National Lab., TN); Harkness, S.D.; Duke, J.M.; Cooper, L.R. *Nucl. Technol.;* **28**: No. 3, 516-536(Mar 1976).

Extensive knowledge and acceptability of pertinent properties, wide fabrication experience, and code acceptance have led to selection of $2^1/_4$ Cr—1 Mo steel for the Clinch River Breeder Reactor Plant steam generators. Limitations of this alloy indicate that further development of high-strength ferritic steels containing 9 to 12 percent chromium and the high-nickel Alloy 800 could lead to superior materials, and programs to develop these materials have started. Combustion Engineering has surveyed the experience with the high-strength ferritic steels and prepared ingots of 26 selected compositions. Charpy V-notch tests and metallography have been used to characterize these alloys, and optimum welding rod compositions for these alloys are under development. Westinghouse-Tampa is undertaking a program to gain code acceptance of Alloy 800. A program has been set up to provide the information required for design and fabrication of reliable components. Progress has been made on characterization, the role of tertiary creep in failure, and the development of welding processes. The Heppenstall Company is demonstrating its process for manufacturing large high-quality ingots. (auth)

POWER REACTORS, AUXILIARY, MOBILE, PACKAGE, AND TRANSPORTABLE

10566 (AI-ERDA—13163) **Systems for nuclear auxiliary power. Annual report, government fiscal year 1975.** (Atomics International Div., Canoga Park, Calif. (USA)). 30 Sep 1975. Contract AT(04-3)-701. 167p. Dep. NTIS $7.60.

The system and component engineering and test activities relating to the ZrH reactor are described. The specific objectives which were pursued during FY 1975 were to: investigate standardized ZrH reactor-TE, -Brayton, and -organic Rankine space power systems and components; perform conceptual analysis and design of ZrH reactor-organic Rankine power systems for subsea applications; perform tests on key space system components; conduct fuel hydriding and hydrogen barrier investigations; and perform system studies in support of the Department of Defense (DOD) and their contractors as directed by the Energy Research and Development Administration (ERDA). (auth)

10567 Thermionic nuclear reactor with internal heat distribution and multiple duct cooling. Fisher, C.R.; Perry, L.W. Jr. (to U.S. Energy Research and Development Administration). US Patent 3,917,509. 4 Nov 1975. Filed date 16 Apr 1974. 4p. PAT-APPL-461,473.

A Thermionic Nuclear Reactor is described having multiple ribbon-like coolant ducts passing through the core, intertwined among the thermionic fuel elements to provide independent cooling paths. Heat pipes are disposed in the core between and adjacent to the thermionic fuel elements and the ribbon ducting, for the purpose of more uniformly distributing the heat of fission among the thermionic fuel elements and the ducts.

REGULATION AND LICENSING

REFER ALSO TO CITATION(S) 10467, 10574, 10577, 10578

10568 (CONF-750117—P2, pp 979-988) **Public information programs in a developing nuclear economy.** Adams, R.M. (Argonne National Lab., IL). 1975.

From International symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In International symposium on nuclear power technology and economics. Volume II.

The importance of public information programs in the development of nuclear power is discussed. The information programs of Argonne National Laboratory and the former USAEC are reviewed. (JWR)

10569 (DOCKET-50003—497) **Indian Point Station, Units 1 and 2. Annual operations report No. 25, 1975.** (Consolidated Edison Co. of New York, Inc., New York (USA)). 1 Mar 1976. 150p. (DOCKET-50247—582). Dep. NTIS $6.00.

Indian Point-1 Reactor remained in the shutdown condition in compliance with NRC's IAC for ECCS. Unit 2 generated 4,889,038 MWH(e) and was on line 8,323.1 hrs. Information is presented concerning operation, maintenance, occupational personnel radiation protection, primary coolant chemistry, abnormal occurrences, changes, tests, and experiments. (FS)

10570 (DOCKET-50010—499) **Dresden Nuclear Power Station, Units 1, 2, and 3. Semiannual report, July—December 1975.** (Commonwealth Edison Co., Chicago, Ill. (USA)). 11 Feb 1976. 202p. (DOCKET-50237—924; DOCKET-50249—755).

Unit 1 net electric power generated was 222,291.82 MWH(e) with the reactor on line 1501:13 hours, Unit 2 generated 2,697,540 MWH(e) and was on line 3979:06 hrs while Unit 3 generated 1,493,824 MWH(e) and was on line 2327:28 hrs. Information is presented concerning operations, fuel performance, surveillance, containment leak testing, shutdowns, maintenance, and primary coolant chemistry. (FS)

10571 (DOCKET-50133—342) **Humboldt Bay Power Plant, Unit 3. Annual operating report, 1975.** (Pacific Gas and Electric Co., San Francisco, Calif. (USA)). 26 Feb 1976. 26p. Dep. NTIS $4.00.

Information is presented concerning operations, changes and forced power reductions, radiation exposures, and fuel experience. (FS)

10572 (DOCKET-50146—129) **Saxton Nuclear Experimental Reactor. Annual report, 1975.** (Saxton Nuclear Experimental Corp., Pa. (USA)). 25 Feb 1976. 4p. Dep. NTIS $3.50.

Information is presented concerning entries into the containment vessel, maintenance changes, surveys of radioactivity levels, water sample analyses, and performance of security and surveillance. (FS)

10573 (DOCKET-50213—484) **Haddam Neck Plant. Annual operating report, 1975.** (Connecticut Yankee Atomic Power Co., Hartford (USA)). 1975. 57p. Dep. NTIS $4.50.

Gross electrical power generated was 2,464,308 MWh(e) with the reactor on line 4,417 hrs. Information is presented concerning operations, power generation, shutdowns, corrective maintenance, primary coolant chemistry, occupational radiation exposure, release of radioactive materials, reportable occurrences, changes in plant, technical specifications, core vi start-up, containment leak testing, and core v and vi refueling. (FS)

10574 (DOCKET-50219—818) **Oyster Creek Nuclear Power Plant, Unit 1. Semiannual report No. 13, July—December 1975.** (Jersey Central Power and Light Co., Morristown, N.J. (USA)). 1975. 89p. Dep. NTIS $5.00.

Net electrical power generated was 1,600,885 MWh(e) with the reactor on line 3,682.2 hrs. Information is presented concerning operations, power generation, shutdowns, corrective maintenance, chemistry and radiochemistry, facility changes, occupational radiation exposure, tests, experiments, release of radioactive materials, and environmental monitoring of atmospheric radiation, fallout, domestic water, surface waters, and marine life. (FS)

10575 (DOCKET-50244—497) **Robert Emmett Ginna Nuclear Power Plant, Unit 1. Annual report No. 11, 1975.** (Rochester Gas and Electric Corp., N.Y. (USA)). 27 Feb 1976. 233p. Dep. NTIS $8.00.

Information is presented concerning operations, power reductions, outages, personnel radiation exposures, failed fuel indications, procedure changes, system modification, and special tests. Results from radiation monitoring of dust, fallout, Lake Ontario water, well water, milk, fruit, aquatic ecosystems, and lake bottoms are tabulated. (FS)

10576 (DOCKET-50245—635) **Millstone Nuclear Power Station, Unit 1. Semiannual operating report, July—December 1975.** (Northeast Nuclear Energy Co., Hartford, Conn. (USA)). 27 Feb 1976. 44p. Dep. NTIS $4.00.

Net electrical power generated was 1,525,943 MWh(e) with the reactor on line 2,682 hrs. Information is presented concerning power generation, shutdowns, corrective maintenance, chemistry and radiochemistry, environmental effects monitoring, release of radioactive materials, and reportable occurrences. Occupational personnel radiation exposures will be submitted later. (FS)

10577 (DOCKET-50285—468) **Fort Calhoun Station, Unit 1. Semiannual report, July—December 1975.** (Omaha Public Power District, Nebr. (USA)). 27 Feb 1976. 157p.

Net electrical power generated was 1,562,051.4 MWH(e) with the reactor on line 3,858.6 hrs. Information is presented concerning operations, power generation, shutdowns, corrective maintenance, primary coolant, chemistry, occupational radiation exposure, release of radioactive materials, and environmental monitoring. (FS)

10578 (DOCKET-50313—489) **Arkansas Nuclear One, Unit 1. Semiannual operating report, July—December 1975.** (Arkansas Power and Light Co., Little Rock (USA)). 5 Mar 1976. 62p. Dep. NTIS $4.50.

Net electrical power generated was 2,857,559 MWh(e) with the reactor on line 3,751.6 hrs. Information is presented concerning operations, power generation, shutdowns, corrective maintenance, occupational radiation exposure, release of radioactive materials, design changes, fuel performance, and results of leak rate tests. (FS)

10579 (DOCKET-50315—462) **Donald C. Cook Nuclear Power Plant, Unit 1. Annual operating report, 1975.** (Indiana and Michigan Power Co., New York (USA)). 1975. 54p. Dep. NTIS $4.50.

Net electrical power generated was 4,457,836,000 MWH(e) with the reactor on line 6004.2 hrs. Information is presented concerning power generation, shutdowns, corrective maintenance occupational radiation exposure, release of radioactive materials, changes, and fuel history. (FS)

10580 (DOCKET-50317—535) **Calvert Cliffs Nuclear Power Plant, Unit 1. Semiannual operating report, July—December 1975.** (Baltimore Gas and Electric Co., Md. (USA)). 1975. 38p. Dep. NTIS $4.00.

Information is presented concerning operations, outages, forced reductions, irradiated fuel examination, personnel radiation exposures, changes, tests, experiments, power changes, and depressurization data. (FS)

10581 (DOCKET-50321—460) **Edwin I. Hatch Nuclear Plant, Unit 1. Annual operating report, 1975.** (Georgia Power Co., Atlanta (USA)). 27 Feb 1976. 121p. Dep. NTIS $5.50.

Net electrical power generated was 3,102,479 MWh(e) with the reactor on line 6,159 hrs. Information is presented concerning power generation, shutdowns, corrective maintenance, reactor coolant chemistry tests, occupational radiation exposure, release of radioactive materials, reportable occurrences, and primary containment local leak rate tests. (FS)

10582 (DOCKET-50324—615) **Brunswick Steam Electric Plant, Unit 2. Annual operating report, 1975.** (Carolina Power and Light Co., Raleigh, N.C. (USA)). 27 Feb 1976. 225p. Dep. NTIS $7.75.

Initial criticality occurred in March and start-up testing continued for most of the year. Information is presented concerning operations, shutdowns, maintenance, design changes, personnel radiation exposures, thermal transients, safety/relief valve malfunctions, condenser tube leaks, and recirculation pump seal failures. (FS)

10583 (DOCKET-50333—486) **James A. FitzPatrick Nuclear Power Plant. Semiannual operating report, July—December 1975.** (Power Authority of the State of New York (USA)). 25 Feb 1976. 65p. Dep. NTIS $4.50.

Net electrical power generated was 1,824,209 MWh(e) with the reactor on line 3,229.2 hrs. Information is presented concerning operation, power generation, shutdowns, corrective maintenance, physics and testing, occupational radiation exposure, release of radioactive materials, and abnormal and reportable occurrences. (FS)

10584 (DOCKET-50336—373) **Millstone Nuclear Power Station, Unit 2. Operating report, August—December 1975.** (Northeast Nuclear Energy Co., Hartford, Conn. (USA)). 1 Mar 1976. 19p. Dep. NTIS $3.50.

Fuel loading started on August 2, 1975 and the reactor was declared commercial on December 26, 1975. Power ascension testing continued through 1975. Information is presented concerning outages, design changes, procedure changes and testing. (FS)

10585 (DOCKET-STN-50561—1) **Babcock and Wilcox Safety Anaysis Report (B-SAR-205). Volume 1.** (Babcock and Wilcox Co., Lynchburg, Va. (USA)). 27 Feb 1976. 545p. Dep. NTIS $13.00.

The design of the BW-205 standard reactor with a plant output of 1295 and 1200 MW(e) is described. The reactor is arranged in two closed coolant loops connected in parallel to the reactor vessel, and is controlled by a coordinated combination of chemical shim and mechanical control rods. The coolant serves as a neutron moderator, reflector, and solvent for the soluble boron used in chemical shim reactivity control. The fuel elements consist of slightly enriched UO_2 pellets enclosed in zircaloy tubes.(FS)

10586 (NUREG/PRDI—76/1) **Power Reactor Docket Information.** (Nuclear Regulatory Commission, Washington, D.C. (USA)). Jan 1976. 123p. TIC $3.50.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the U. S. Nuclear Regulatory Commission in support of applications for construction and operating licenses Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by nuclear power plant name. (JWR)

10587 (REG/G—1.104(2-76)) **Overhead crane handling systems for nuclear power plants.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Standards Development). Feb 1976. 10p. NUREG.

Methods acceptable to the NRC for complying with regulations with regard to the design, fabrication, and testing of overhead crane systems for reactor refueling and spent fuel handling operations are described. (JWR)

10588 (REG/G—1.114(2-76)) **Guidance on being operator at the controls of a nuclear power plant.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Standards Development). Feb 1976. 2p. NUREG.

10589 (STI/PUB—421) **Licensing and regulatory control of nuclear installations. Legal Series No. 10. Proceedings of conferences held in Rio de Janeiro, 25—29 June 1973, and in Athens, 16—20 December 1974.** (International Atomic Energy Agency, Vienna (Austria)). 1975. 316p. (In English and French). (CONF-7306129—; CONF-741260—). IAEA $19.00.

From Seminar on licensing and regulatory control of nuclear installations; Rio De Janeiro, Brazil (25 Jun 1973).

Abstracts for all 19 papers are included in NSA and abstracts for 2 papers are included in ERA. (JWR)

10590 (TID—27005) **Opinions and decisions of the Atomic Energy Commission with selected orders. Progress report, July 1, 1972—December 31, 1972.** (Energy Research and Development Administration, Washington, D.C. (USA)). 1974. 472p. GPO $8.40.

Issuances of the Atomic Energy Commission, the Atomic Safety and Licensing Board, the Atomic Safety and Licensing Appeal Board, and the Board of Contract Appeals during the period July through December 1972 are presented.

10591 **Licensing of nuclear power plants in the United States of America with special emphasis on environmental protection.** Becker, J.M. (Atomic Energy Commission, Washington, DC). pp 59-77 of In Licensing and regulatory control of nuclear installations. Vienna; International Atomic Energy Agency (1975).

From Seminar on licensing and regulatory control of nuclear installations; Rio De Janeiro, Brazil (25 Jun 1973).

See STI/PUB—421; CONF-7306129—.

The National Environmental Policy Act (NEPA), 1969, and its interpretation by federal courts have resulted in a significant change in the licensing of nuclear facilities in the USA. Application for a construction permit must be accompanied by a safety analysis report and an environmental report. Concurrently with safety reviews performed by the regulatory staff of the Atomic Energy Commission and the Advisory Committee on Reactor Safeguards (ACRS), an environmental review is carried out. Separate public hearings are held to consider the safety and environmental issues involved. After a decision is issued by the Atomic Safety and Licensing Board, a party may appeal to an Appeal Board and the Appeal Board's decision may be subject to review by the Commission. Application for an operating license must include a final safety analysis report and a second environmental report, which again are reviewed by the Commission's staff and ACRS. An opportunity for public hearing is afforded upon completion of this review process. Apart from NEPA, the most important environmental protection statute involved in the licensing of nuclear power reactors is the Federal Water Pollution Control Act, which regulates discharges into navigable waters. Other applicable provisions are contained in the Clean Air Act, the Wild and Scenic Rivers Act and the National Historic Preservation Act. (auth)

10592 Recent effective and proposed improvements in the nuclear power plant licensing process in the United States of America. Engelhardt, T.F. (Atomic Energy Commission, Washington, DC). pp 223-241 of In Licensing and regulatory control of nuclear installations. Vienna; International Atomic Energy Agency (1975).

From Seminar on licensing and regulatory control of nuclear installations; Athens, Greece (16 Dec 1974).

See STI/PUB—421; CONF-741260—.

In his 18 April 1973 message to Congress on energy the US President noted that nuclear technology represented an indispensable source of energy for meeting current requirements and stated the need to avoid unreasonable delays in developing nuclear power by streamlining licensing procedures and by reducing overlapping jurisdictions. The Energy Reorganization Act of 1974 abolished the Atomic Energy Commission and transferred its licensing and regulatory functions to an independent regulatory commission, the Nuclear Regulatory Commission; a new Energy Research and Development Administration was concurrently established, vested with central responsibility for the planning, management and conduct of the Government's energy research and development. A number of administrative and legislative reforms that have been taken or are under way to improve and shorten the present nuclear facility licensing and regulatory process are described. It is estimated that full implementation of the "standardization" and "early site permit" concepts could reduce the overall time required to bring a nuclear power plant on line from the current ten years to six years or less. And this is being aimed at without compromising the thoroughness of the safety, environmental or antitrust licensing reviews, or sacrificing public participation in the licensing process. (auth)

10593 (REG/G—1.27(Rev.2)(1-76)) **Ultimate heat sink for nuclear power plants.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Standards Development). Jan 1976. 5p. NUREG.

An acceptable basis for implementing design criteria concerning ultimate heat sinks utilizing water sources is presented. (JWR)

10594 (REG/G—1.85(Rev.5)(2-76)) **Code case acceptability: ASME Section III materials.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Standards Development). Feb 1976. 6p. NUREG.

Code Cases of Section III ASME Boiler and Pressure Vessel Code oriented toward materials and testing that are acceptable in the licensing of LWR power plants are listed. (JWR)

10595 (REG/G—1.84(Rev.5)(2-76)) **Code case acceptability: ASME Section III design and fabrication.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Standards Development). Feb 1976. 6p. NUREG.

Code Cases of the Section III ASME Boiler and Pressure Vessel Code that are acceptable for the design and fabrication of LWR power plant components are listed. (JWR)

ECONOMICS

REFER ALSO TO CITATION(S) 10881, 10882

10596 (AAEC/IP—10) **Energy accounting in nuclear power systems.** Symonds, J.L.; Essam, P.; Stocks, K. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct 1975. 29p. Dep. NTIS (US Sales Only) $4.00.

The application of energy accounting to nuclear power stations and their growth in generating systems is discussed. Misunderstandings arising from discrepancies and weaknesses in some published simple analyses of hypothetical growth situations are outlined. Results of a more complex energy flow analysis are used to demonstrate that current nuclear energy programs are running at an energy profit. Large fossil fuel savings will occur in a real electrical grid system under anticipated nuclear power growth rates. (auth)

10597 (CONF-750117—P2) **International symposium on nuclear power technology and economics, January 13—20, 1975, Taipei, Republic of China. Volume II.** (Institute of Nuclear Energy Research, Lung-Tan (Taiwan); National Science Council, Taipei (Taiwan)). 1975. 652p. National Science Council, Taipei, Taiwan.

From International symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

Twenty-three papers are presented on aspects of nuclear power technology and economics relevant to countries in the Far East in developing a program of commercial nuclear energy. A separate abstract was prepared for each of 21 papers. Two papers were also processed for inclusion in ERDA Research Abstracts. One paper was previously cited in NSA. (HDR)

10598 Evolving incentives and technical programs for attaining higher plant productivities. Zebroski, E.L.; Lapides, M.E. (Electric Power Research Inst., Palo Alto, CA). *Proc. Am. Power Conf.*; **37**: 178-193(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

Included are discussions on quantifying fuel conservation and cost incentives for increasing nuclear plant productivity, value of improvements in technology, possible avenues of plant productivity increases, causes of plant outage, failure mode analysis, quality assurance levels for components and materials, and cost/benefit analysis of improvement programs. (DG)

FUEL CYCLE

REFER ALSO TO CITATION(S) 10312, 10313, 10315, 10483

10599 (NP—20838) **Nuclear power and uranium fuel: requirements in the Western United States.** (Western Interstate Nuclear Board, Lakewood, Colo. (USA)). Oct 1975. 37p. Western Interstate Nuclear Board, Lakewood, CO.

The results are presented of a survey of nuclear power and associated uranium fuel cycle requirements in the Western Region recently conducted by the Western Interstate Nuclear Board (WINB). The survey covers the period 1975—1990 for electric energy and nuclear power except for uranium and other fuel cycle requirements which is limited to the period 1975—1985. This shorter time span coverage for fuel cycle requirements was chosen due to many uncertainties in future federal policy in such areas as uranium enrichment, plutonium utilization in light water reactors, spent fuel reprocessing, and high-level radioactive waste management. Geographically, the survey covered the twelve western states served by WINB. Also contained is information on projected national and western regional trends in electric energy demand and supply developed by the U. S. Energy Research and Development Administration (ERDA), the Western Systems Coordinating Council (WSCC), and other organizations. This information is presented as background material for assessing nuclear power in the West and nation in its proper perspective as one of several major energy sources available for general application during the period 1975—1990.

10600 Comparison of advanced fission reactors in a nuclear power economy. Denning, R.S.; Madia, W.J.; Pardue, W.M.; Pobereskin, M.; Waddell, J.D.; Willke, T.L. (Battelle—Columbus Labs., OH). *Trans. Am. Nucl. Soc.*; **22**: 331-332(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10601 Application of the thorium fuel cycle. Kasten, P.R.; Tobias, M.L. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; **22**: 334(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

PROCESS HEAT REACTORS

REFER ALSO TO CITATION(S) 10379, 10482, 10492, 10493, 10876

10602 (ANL—76-6) **Physics of reactor safety. Quarterly report, July—September 1975.** (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 25p. Dep. NTIS $5.00.

Included are reports on reactor safety research and technical coordination of the RSR safety analysis program by members of the Reactor Safety Appraisals Group, Monte Carlo analysis of safety-related critical assembly experiments by members of the Theoretical Fast Reactor Physics Group, and planning of DEMO safety-related critical experiments by members of the Zero Power Reactor (ZPR) Planning and Experiments Group.

10603 (CONF-750758—(Summ.), pp 3-7) **Overview of ERDA investigations on nuclear industrial energy.** Beresovski, T. (Energy Research and Development Administration, Washington, DC). Oct 1975.

From Meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America "USA" (31 Jul 1975).

In Summaries of papers presented at the meeting on small nuclear reactors for industrial energy.

A brief survey of ERDA studies on industrial use of nuclear process heat, particularly as supplied by small nuclear plants, is presented. (JWR)

10604 (CONF-750758—(Summ.), pp 10-27) **Future industrial energy options.** Klepper, O.H. (Oak Ridge National Lab., TN). Oct 1975.

From Meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America "USA" (31 Jul 1975).

In Summaries of papers presented at the meeting on small nuclear reactors for industrial energy.

Industrial energy options and the potential future role of small nuclear reactors are examined. (JWR)

10605 (CONF-750758—(Summ.), pp 89-94) **Small nuclear process heat plants.** Jones, A.R. (Westinghouse Astronuclear Lab., Pittsburgh). Oct 1975.

From Meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America "USA" (31 Jul 1975).

In Summaries of papers presented at the meeting on small nuclear reactors for industrial energy.

The need for small nuclear process heat plants is briefly discussed. The possible economic advantages of cooperative arrangements for larger multi-use plants are pointed out. The current technology of small nuclear plants is reviewed. (JWR)

10606 (CONF-750758—(Summ.), pp 107-117) **Industrial potential for nuclear process steam.** Barnes, R.W. (Dow Chemical, Midland, MI). Oct 1975.

From Meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America "USA" (31 Jul 1975).

In Summaries of papers presented at the meeting on small nuclear reactors for industrial energy.

An assessment of the potential market for nuclear process steam is presented. The potential for barge-mounted small nuclear reactors is briefly discussed. (JWR)

NUCLEAR REACTOR TECHNOLOGY

10607 Transactions of the American Nuclear Society 1975 winter meeting, San Francisco, California, November 16—21, 1975. Farmakes, R. (ed.). *Trans. Am. Nucl. Soc.*; **22**: 1-836(Nov 1975).

Each of the brief summaries of the papers presented at the meeting is listed by title in NSA. The summaries cover sessions on civil explosion application, controlled fusion, environmental sciences, isotopes and radiation, materials, mathematics, criticality safety, fuel cycle, reactor technology, remote systems technology, shielding, and dosimetry. (HDR)

THEORY AND CALCULATION

REFER ALSO TO CITATION(S) 10753

10608 (HEDL-SA—928-S) **Nuclear data for calculation of radioactivity effects.** Schenter, R.E.; England, T.R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 20 Feb 1975. Contract AT(45-1)-2170. 7p. (CONF-750607—51). Dep. NTIS $3.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

LOCA analyses require nuclear data for decay heating calculations for short cooling times (t/sub c/ less than 1000 sec). These same data, however, are also applicable to problems involving longer cooling times and additional related studies using calculations of radioactivity effects associated with fast and thermal reactor systems. These include absorption buildup, waste disposal and fuel management, shielding (spectra), fuel integrity (fission gas content), and buildup of radiologically hazardous and toxic products. Three examples are given using these recently developed nuclear data files. The examples present calculational results and comparison with evaluations of integral experiments of decay heat, delayed and prompt neutron yields, and γ-spectra for photoneutron production.

10609 (NUREG—75/099) **Evaluation of fission product afterheat. Annual report, May 1, 1974—June 30, 1975.** Spinard, B.I. (Oregon State Univ., Corvallis (USA). Dept. of Nuclear Engineering). 1975. 114p. NTIS $5.50.

Studies are described which were undertaken to develop and justify a method for predicting, according to an appropriate graph, formula, or algorithm, the power generated by fission products after a sudden shutdown of a power reactor as a function of time after shut down. Included are sections on fission yield data and errors, preparatory studies, and calculation of decay power. (DG)

10610 Groupwise rebalancing technique for integral transport problems. Cheng, H.S. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.*; **22**: 244-245(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10611 Optimized iteration strategies for fast reactor finite-difference diffusion theory codes. Ferguson, D.R. (Argonne National Lab., IL); Derstine, K.L.; Borg, R.C.; Daly, T.A. *Trans. Am. Nucl. Soc.*; **22**: 245-246(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10612 Solution of the diffusion of P_1 finite element equations by iteration. Tomlinson, E.T. (Univ. of Tennessee, Knoxville); Robinson, J.C.; Vondy, D.R. *Trans. Am. Nucl. Soc.*; **22**: 248(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10613 Analytic solution of the monoenergetic time-dependent albedo problem. Ganapol, B.D. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 255-256(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10614 Effect of void streaming on flux shapes near vacuum boundaries. Gelbard, E.M. (Argonne National Lab., IL); Lell, R. *Trans. Am. Nucl. Soc.*; **22**: 257-258(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10615 Column separation treatment of cavitation for pressure transient analyses. Kot, C.A.; Youngdahl, C.K. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 273(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10616 Two-dimensional fluid-hammer problems by the method of nearcharacteristics. Shin, Y.W.; Kot, C.A. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 273-275(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10617 Poison distribution resulting in a desired power distribution. Tzanos, C.P. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 327-328(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10618 **Parametric studies concerning actinide transmutation in power reactors.** Croff, A.G. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; **22**: 345-346(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10619 **Analysis of the microfusion reactor concept.** Cole, R.K. Jr.; Renken, J.H. (Sandia Labs., Aluquerque, NM). *Nucl. Sci. Eng.*; **58**: No. 4, 345-353(Dec 1975).

There is current interest in the possibility that symmetric irradiation of a small pellet of fissionable material by intense laser beams may produce sufficient compression to cause the pellet to become supercritical and thus produce a fission microexplosion. It has been proposed that a repetitive series of such explosions in a suitable chamber could be the basis for an alternative means of generating commercial power from nuclear energy. An analysis of this scheme is presented that shows that the energetics do not appear favorable for power generation purposes. Although an input of several hundred megajoules of radiation energy is necessary to trigger a microexplosion, the idea appears to be an interesting physics experiment. Such microexplosions would be unique short-duration sources of nuclear radiations. (auth)

10620 **Sensitivity theory from a differential viewpoint.** Oblow, E.M. (Oak Ridge National Lab., TN). *Nucl. Sci. Eng.*; **59**: No. 2, 187-189(Feb 1976).

An alternate derivation of sensitivity functions in terms of functional derivatives is presented to interpret sensitivity results from a differential viewpoint. No reference is made in this approach to perturbations or variations in defining sensitivity functions so that they can be seen to be "exact" differential quantities. The differential approach should allow sensitivity methods to be applied more easily to simple model problems in the areas of shielding and core physics, since these problems can be analyzed in terms of functional derivatives. (auth)

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 10640, 10753

10621 (CONF-750117—P1, pp 353-370) **Flow-induced vibrations of reactor internal and plant components.** Chen, S.S. (Argonne National Lab., IL). 1975.

From International symposium on nuclear power technology and economics; Taipei, China, Mainland (13 Jan 1975).

In International symposium on nuclear power technology and economics. Volume I.

The current literature on flow induced vibrations in reactors is summarized. Several types of vibrations are discussed and methods of analysis for each type are described. General design guidelines for minimizing vibration problems are also discussed. (JWR)

10622 (EUR—5395(Vol.1)) **International colloquium on high-temperature in-pile thermometry held at J.R.C., Petten, Netherlands, December 12—13, 1974.** von der Hardt, P.; Zeisser, P.; Mason, F. (eds.). (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment). 1975. 439p. (In French and English). (CONF-741226—P1). Commission of the European Communities, Luxembourg.

From International colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

Included are nineteen papers dealing with fabrication, design, and performance of thermocouples for high temperature applications. Separate abstracts and indexing were prepared for each paper. (DG)

10623 (EUR—5395(Vol.1), pp 1-23) **Highly stable, sheathed, beryllia insulated, tungsten—rhenium alloy thermocouples.** Burns, G.W.; Hurst, W.S. (National Bureau of Standards, Washington, DC). 1975.

From International colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In International colloquium on high-temperature in-pile thermometry.

The fabrication and performance testing of 1.6 mm diameter tantalum sheathed, beryllium oxide (BeO) insulated, W-3 percent Re/W-25 percent Re thermocouples are reported. Fully assembled thermocouples constructed from aged thermoelements, specially heat treated, sintered BeO insulators, and specially cleaned and etched tantalum sheaths were tested for 2059 h at 1800°C in a helium environment. The measured thermal emf drifts were less than the equivalent of 1°C per thousand hours of exposure at 1800°C. No gross chemical attack or degradation of the component materials was evident. The fabrication techniques, thermal emf test results, and post-test analyses of the component materials are discussed. (auth)

10624 (EUR—5395(Vol.1), pp 237-268) **Correction of irradiation-produced drift in W—Re fuel centerline thermocouples.** Shepard, R.L.; Kollie, T.G. 1975.

From International colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In International colloquium on high-temperature in-pile thermometry.

The calibration drift occurring in W—Re fuel centerline thermocouples in an in-pile experiment can be determined quantitatively during irradiation and corrected for by measuring both the thermocouple output and the electrical resistance of the thermocouple loop and applying Matthiesen's rule to interpret the results. The temperature error in a particular experiment is strongly affected by the temperature gradient along the thermocouple. Some generalizations can be made about the effects of irradiation temperature and neutron flux on thermocouple drift rate, however, variations in temperature gradient among experiments preclude direct comparisons and make post-irradiation calibration difficult to interpret. These complications require the development of an on-line method for drift correction. A description is given of such a method. (auth)

10625 (EUR—5395(Vol.1), pp 325-342a) **New thermocouples for the measurement of temperatures above 1000°C.** Schley, R.; Liermann, J.; Metauer, G.; Gentil, J. (CEN, Saclay, France). 1975.

From International colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In International colloquium on high-temperature in-pile thermometry.

An investigation of the Mo/Nb thermocouple is presented under the following headings: study of the e.m.f, influences of recrystallization, study of the influence on the e.m.f of adding Mo to the negative leg, and study of the compensation wires between 0°C and 300°C. (auth)

10626 (EUR—5395(Vol.2)) **International colloquium on high-temperature in-pile thermometry held at J.R.C., Petten, Netherlands, December 12—13, 1974.** von der Hardt, P.; Zeisser, P.; Mason, F. (eds.). (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; UKAEA Research Group, Harwell. Atomic Energy Research Establishment). 1975. 407p. (In several languages). (CONF-741226—P2). Commission of the European Communities, Luxembourg.

From International colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

Included are nineteen papers dealing with thermocouples and ultrasonic and noise thermometry. Separate abstracts and indexing were prepared for eighteen papers. (DG)

10627 (EUR—5395(Vol.2), pp 585-615) **Radiation induced E.M.F. developing in the insulation of metal sheathed mineral insulated high temperature thermocouples and its effects of the thermocouple signal.** Tarassenko, S. (AEE, Winfrith, Eng.). 1975.

From International colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In International colloquium on high-temperature in-pile thermometry.

The behaviour and performance of tungsten-rhenium thermocouple instrumentation in DRAGON reactor irradiation experiments is briefly reviewed. A particular emphasis is put on the existence and origin of EMF signals induced within the insulant of such thermocouples and distributed along the "hot zone" part of the thermoelectric circuit. It is shown how a thermocouple failure caused by a hardly detectable open circuit can result in a misleading interpretation of the temperature reading, with the inherent consequences regarding the reactor operation. (auth)

10628 (EUR—5395(Vol.2), pp 737-774) **Ultrasonic and Johnson noise fuel centerline thermometry.** Shepard, R.L.; Borkowski, C.J.; East, J.K.; Fox, R.J.; Horton, J.L. (Oak Ridge National Lab., TN). 1975.

From International colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In International colloquium on high-temperature in-pile thermometry.

Rhenium ultrasonic (UST) and Johnson noise (JNT) thermometers were used to measure fuel centerline temperatures of 900—1500°C in capsules irradiated in the HFIR for periods of 1000—3000 hrs. Transmutation of rhenium by thermal neutron absorption caused large drifts in UST calibration but none in JNT calibration. Whole capsule, post irradiation calibration was used to

measure drift in UST and to provide a calibration correction. Calculation of the temperature and the resistance of JNT rhenium sensor elements by noise power measurements have shown no temperature drift in over 1100 hrs at 1250°C. Performance of W—Re thermocouples UST and JNT in fuel irradiation centerline thermometry is compared. (auth)

10629 (ORNL—5035) **FLANGE: a computer program for the analysis of flanged joints with ring-type gaskets.** Rodabaugh, E.C.; O'Hara, F.M. Jr.; Moore, S.E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 139p. Dep. NTIS $7.75.

The computer program FLANGE was written to calculate not only the stresses due to moment loads on the flange ring but also stresses due to internal pressure; stresses due to a temperature difference between the hub and ring; and stresses due to the variations in bolt load that result from pressure, hub-ring temperature gradient, and/or bolt-ring temperature difference. The program FLANGE is applicable to tapered-hub, straight, and blind flanges. The analysis method is based on the differential equations for thin plates and shells. The stresses due to moment loading calculated by the two methods are essentially identical for identical boundary conditions. A description of the general model of flanges used in the theoretical development of the computer code is provided. The actual mathematical expressions for calculating stresses and displacements due to moment and pressure loads are derived. Example calculations, listings, and flowcharts of the program and its subroutines are included as appendices. (auth)

10630 (ORNL-TM—5108) **Monthly progress report for September 1975 for the HTGR safety studies for the Division of Technical Review, U.S. Nuclear Regulatory Commission.** Sanders, J.P. (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. Contract W-7405-eng-26. 7p. Dep. NTIS $4.00.

10631 (RDT-F—8-7T(1-76)) **Transportation of critical components and equipment.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Development and Demonstration). Jan 1976. 21p. RSO.

A standard is presented which covers recommended practices in the planning, coordination, and administration of shipments of critical components and equipment for nuclear facilities. The standard supplements and is additive to the rules and regulations of freight classifications and tariffs governing carriers and shipping, and has the purpose of minimizing the liklihood of physical damage or deterioration of critical components and equipment due to collision, upset, shock, vibration, corrosion, or other conditions of the transport environment. (auth)

10632 Device for handling fuel assemblies within a nuclear reactor core. Dupuy, G. (to Commissariat a l'Energie Atomique). US Patent 3,909,350. 30 Sep 1975. Priority date 18 May 1972, France. 8p.

A device is described which comprises two arms having synchronized movements, the tubular portions of the two arms being rigidly fixed to each other by means of a sliding connection and capable of being endowed by means of a differential drive system with movements for producing the same effort but applied in the opposite direction in order that the lateral reaction on the grab of the first arm on a fuel assembly should be equal and opposite to the lateral reaction of the cylindrical guide tube of the second arm on the same fuel assembly. (Official Gazette)

10633 Method and apparatus for removing an incore neutron flux monitor. Tsuji, T.; Watanabe, S. (to Tokyo Shibaura Denki Kabushiki Kaisha). US Patent 3,910,816. 7 Oct 1975. Priority date 5 Sep 1973, Japan. 6p.

In a nuclear reactor wherein four square shaped fuel rod assemblies are disposed in respective square shaped openings defined by crossing grids of an upper supporting plate, and an in-core monitor is disposed at a cross-point of the grids, the in-core monitor is removed by removing four fuel rod assemblies adjacent the in-core monitor, removing one fuel rod assembly from each of three square shaped openings about the in-core monitor, inserting a holder-cutter assembly into a large vacant space formed by removing the four fuel rod assemblies for holding the upper portion of the in-core monitor, inserting a clamping device into one small vacant space formed by removing one of the three fuel rod assemblies which is diagonally opposite the removed fuel rod assembly for clamping a portion of the in-core monitor which is spaced apart from the portion thereof held by the holder of the holder-cutter assembly, severing the in-core monitor into two sections by operating the cutter, and removing to the outside of the reactor the severed two sections while they are held by the clamping device and the holder, respectively. (Official Gazette)

10634 Core for nuclear reactors. Andersson, I.; Eriksson, O. (to ASEA-ATOM). US Patent 3,913, 689. 21 Oct 1975. Priority date 11 Aug 1972, Sweden. 2p.

A description is given of a core for a nuclear reactor which includes a moderator tank and fuel assemblies within the moderator tank. The tank has a lid. The fuel assemblies are fixed by an assembly grid shaped as a lattice, each fuel assembly including a polygonal shroud and a plurality of control rod guide tubes surrounded by the shroud. The walls of the shrouds extend upwardly above the control rod guide tubes. The grid is secured in place by the lid of the moderator tank. The grid has mechanical contact with the upper edges of the shrouds, the vertical planes along the surface of the grids crossing the planes along the surfaces of the shrouds. The mechanical contact is made by downwardly open slots in the sheet metal parts constituting the grid which engage the upwardly extending edges of the shroud. (Official Gazette)

10635 Transition section for acoustic waveguides. Karplus, H.H.B. (to U.S. Energy Research and Development Administration). US Patent 3,915,018. 28 Oct 1975. Filed date 21 Nov 1974. 12p.

PAT-APPL-526,038.

A means of facilitating the transmission of acoustic waves with minimal reflection between two regions having different specific acoustic impedances is described comprising a region exhibiting a constant product of cross-sectional area and specific acoustic impedance at each cross-sectional plane along the axis of the transition region. A variety of structures that exhibit this feature is disclosed, the preferred embodiment comprising a nested structure of doubly reentrant cones. This structure is useful for monitoring the operation of nuclear reactors in which random acoustic signals are generated in the course of operation.

10636 Use of variational techniques for the estimation of neutron detection efficiency. Lin, S.C. (Univ. of Tennessee, Knoxville); Robinson, J.C.; Flanagan, G.F. *Trans. Am. Nucl. Soc.;* **22**: 239-240(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10637 (RDT-F—1-2T(Rev.)(12-75)) **Preparation of system design descriptions.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Development and Demonstration). Dec 1975. 24p. RSO.

A standard is presented which prescribes the purpose, scope, organization, and content of system design descriptions (SSD's), in order to promulgate a unified approach to their preparation and use by a project as the principal means to establish, describe, and control the individual system designs from conception and throughout the lifetime of the system. SDD's are comprehensive technical documents that specifically and completely define the design, including operation, maintenance, and reliability requirements, of individual systems which comprise a nuclear power plant or test facility. SDD's are prepared and maintained current by the responsible system designer and are the principal means of system design definition and control common to the designer and the other participating organizations responsible for the project. (auth)

10638 Pipe gripper. Moyers, S.M. (to U.S. Energy Research and Development Administration). US Patent 3,925,874. 16 Dec 1975. Filed date 9 Jul 1974. 4p.

PAT-APPL-486,924.

A device for gripping the exterior surface of a pipe or rod is described which has a plurality of wedges, each having a concave face which engages the outer surface of the pipe and each having a smooth face opposing the concave face. The wedges are seated on and their grooved concave faces are maintained in circular alignment by tapered axial segments of an opening extending through a wedge-seating member. The wedges are allowed to slide across the tapered axial segments so that such a sliding movement acts to vary the diameter of the circular alignment.

FUEL ELEMENTS

REFER ALSO TO CITATION(S) 10307

10639 (AECL—5104) **In-reactor thermal conductivity of U—Si—Al.** Fehrenbach, P.J.; Cotnam, K.D.; Morel, P.A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nov 1975. 44p. Dep. NTIS (US Sales Only) $4.00. AECL $1.00.

A solid U—Si—Al element clad in cold-worked Zr—2.5 wt percent Nb and containing four internal thermocouples was ir-

radiated to a burnup of about 50 MWh/kg U at a linear power of 55 kW/m (182 MeV/fission). The central fuel temperature at full power decreases continuously from 817 K just after the initial startup to 782 K after a burnup of 50 MWh/kg U. The thermal conductivity determined from data obtained from the initial reactor startup fit the relation lambda (T) = 0.0108 + 2.52 x 10^{-5} (T-273) $kWm^{-1}K^{-1}$. This agrees to within 5 percent of data obtained independently from out-reactor tests. Irradiation caused a small decrease in conductivity at temperatures below 675 K and a corresponding slight increase in the temperature sensitivity. At a burnup of 40 MWh/kg U the in-reactor data fit the relation lambda (T) = 0.00776 + 3.32 x 10^{-5} (T-273) $kWm^{-1}K^{-1}$. Both of these relations result in a thermal conductivity 10 percent to 20 percent lower than that for U_3Si. The observed decrease in operating fuel temperature is consistent with an increase in fuel/sheath heat transfer coefficients with burnup, which has been postulated for uranium silicide fuel elements. Heat transfer coefficients calculated from data obtained in this experiment ranged from 25 $kWm^{-2}K^{-1}$ for fresh fuel to 160 $kWm^{-2}K^{-1}$ after a burnup of 40 MWh/kg U.

10640 (EUR—5395(Vol.2), pp 623-632) **Fabrication of internally instrumented reactor fuel rods.** Schmutz, J.D.; Meservey, R.H. (Aerojet Nuclear Co., Idaho Falls, ID). 1975.

From International colloquium on high temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In International colloquium on high-temperature in-pile thermometry.

Procedures are outlined for fabricating internally instrumented reactor fuel rods while maintaining the original quality assurance level of the rods. Instrumented fuel rods described in this report contain fuel centerline thermocouples, ultrasonic thermometers, and pressure tubes for internal rod gas pressure measurements. Descriptions of the thermocouples and ultrasonic thermometers are also contained. (auth)

10641 **Restraint system for core elements of a reactor core.** Class, G. (to Gesellschaft fuer Kernforschung mbH). US Patent 3,900,367. 19 Aug 1975. Priority date 15 Dec 1971, German, Federal Republic of (F.R. Germany). 8p.

In a nuclear reactor, a core element bundle formed of a plurality of side-by-side arranged core elements is surrounded by restraining elements that exert a radially inwardly directed restraining force generating friction forces between the core elements in a restraining plane that is transverse to the core element axes. The adjoining core elements are in rolling contact with one another in the restraining plane by virtue of rolling-type bearing elements supported in the core elements. (Official Gazette)

10642 **Electric cartridge-type heater for producing a given nonuniform axial power distribution.** Clark, D.L.; Kress, T.S. (to U.S. Energy Research and Development Administration). US Patent 3,912,908. 14 Oct 1975. Filed date 12 Nov 1974. 4p.

PAT-APPL-523,183.

An electric cartridge heater is provided to simulate a reactor fuel element for use in safety and thermal-hydraulic tests of model nuclear reactor systems. The electric heat-generating element of the cartridge heater consists of a specifically shaped strip of metal cut with variable width from a flat sheet of the element material. When spirally wrapped around a mandrel, the strip produces a coiled element of the desired length and diameter. The coiled element is particularly characterized by an electrical resistance that varies along its length due to variations in strip width. Thus, the cartridge heater is constructed such that it will produce a more realistic simulation of the actual nonuniform (approximately "chopped" cosine) power distribution of a reactor fuel element.

10643 **Inspection and repair apparatus for a nuclear reactor fuel assembly.** Shallenberger, J.M.; Hornak, L.P.; Desmarchais, W.E. (to Westinghouse Electric Corp.). US Patent 3,914,613. 21 Oct 1975. Filed date 6 Feb 1974. 8p.

An apparatus is disclosed for inspecting and repairing a radioactive fuel assembly. The radioactive fuel assembly is positioned within a shielding sleeve which substantially reduces the level of radioactivity immediately surrounding the sleeve thereby permitting direct access by operating personnel. In one embodiment, a rotatable collar is mounted to the sleeve at a midlength location. An access port, an inspection port and an instrument port are included with the collar so that operating personnel may directly inspect the fuel assembly and effectuate any necessary repairs. (Official Gazette)

10644 **Results of QA inspections at fuel vendors.** Tripp, L.E. (Nuclear Regulatory Commission, Washington, DC). *Trans. Am. Nucl. Soc.*; **22**: 359(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10645 **Fuel or irradiation subassembly.** Seim, O.S.; Hutter, E. (to U.S. Energy Research and Development Administration). US Patent 3,928,126. 23 Dec 1975. Filed date 9 Jul 1974. 4p.

PAT-APPL-486,787.

A subassembly for use in a nuclear reactor is described which incorporates a loose bundle of fuel or irradiation pins enclosed within an inner tube which in turn is enclosed within an outer coolant tube and includes a locking comb consisting of a head extending through one side of the inner sleeve and a plurality of teeth which extend through the other side of the inner sleeve while engaging annular undercut portions in the bottom portion of the fuel or irradiation pins to prevent movement of the pins.

CONTROL SYSTEMS

10646 (GA-A—13740) **Gas turbine HTGR program. Semiannual progress report, July 1, 1975—December 31, 1975.** (General Atomic Co., San Diego, Calif. (USA)). 29 Jan 1976. Contract E(04-3)-167. vp. Dep. NTIS $7.60.

Progress is reported in investigations supporting the technology for, and establishing the reference baseline design of, the helium Gas-Turbine High-Temperature, Gas-Cooled Reactor (GT-HTGR). These investigations include reactor plant systems and dynamics, plant safety, primary pressure boundary, turbomachinery, helium valves and heat exchangers, fission-product effects, materials, and Helium Component Test Facility (HCTF) requirements. Results of privately supported work on the GT-HTGR are reported to the extent that they relate to ERDA-supported work.

10647 **Hydraulic balancing of a control component within a nuclear reactor.** Marinos, D.; Ripfel, H.C.F. (to U.S. Energy Research and Development Administration). US Patent 3,912,582. 14 Oct 1975. Filed date 16 Aug 1974. 8p.

PAT-APPL-498,147.

A reactor control component includes an inner conduit, for instance containing neutron absorber elements, adapted for longitudinal movement within an outer guide duct. A transverse partition partially encloses one end of the conduit and meets a transverse wall within the guide duct when the conduit is fully inserted into the reactor core. A tube piece extends from the transverse partition and is coaxially aligned to be received within a tubular receptacle which extends from the transverse wall. The tube piece and receptacle cooperate in engagement to restrict the flow and pressure of coolant beneath the transverse partition and thereby minimize upward forces tending to expel the inner conduit.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 10334, 10682, 10839, 11438, 11458, 11484, 11553, 11557

10648 (BNWL-B—472) **Review of existing studies and unresolved problems associated with socio-economic impact of nuclear powerplants.** Hendrickson, P.L.; King, J.C.; O'Connell, M.S. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1975. Contract E(45-1)-1830. 33p. Dep. NTIS $4.00.

Preparation of socio-economic impact statements for nuclear powerplants began only a few years ago. The number of these statements is increasing, and some states, such as Washington, now require them as a condition to state approval for thermal powerplants. The major purpose of this paper was to review existing socio-economic impact statements to identify where additional research to improve the impact analysis process would be useful and appropriate. A second purpose was to summarize the type of information included in existing statements. Toward this end a number of socio-economic impact statements were reviewed. Most of the statements are for nuclear power plants; however, some are for other large construction projects. The statements reviewed are largely predictive in nature; i.e., they attempt to predict socio-economic impacts based on the existing knowledge. A few of the reports contain retroactive case studies of plants already completed. One describes an ongoing monitoring analysis of plants under construction. As a result of this preliminary study, a need was identified for a better-defined impact statement methodology and for guidelines identifying appropriate areas for analysis and analytical techniques. (auth)

10649 (BNWL-SA—5497) **Preparation of environmental impact statements: radiological considerations.** Unruh, C.M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 44p. (CONF-751101—67). Dep. NTIS $4.00.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

A comprehensive analysis of potential radiological impact needs to be developed in nuclear power reactor impact statements. The analysis should examine the pathways that may result in radioactive material from effluents and waste streams interacting with man and biota. Each facility location and proposed mode of operation needs independent study to establish the principal and significant pathways of radiation exposure. (auth)

10650 (ORNL/TM—5014(Vol.3)) **Comparison between dispersed nuclear power plants and a nuclear energy center at a hypothetical site on Kentucky Lake, Tennessee.** Fitzpatrick, F.C.; Gray, D.D.; Hyndman, J.R.; Sisman, O.; Suffern, J.S.; Tyrrell, P.A.; West, D.C. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 121p. Dep. NTIS $7.00.

The thermal, ecological, and social impacts of a 40-reactor NEC are compared to impacts from four 10-reactor NECs and ten 4-reactor power plants. The comparison was made for surrogate sites in western Tennessee. The surrogate site for the 40-reactor NEC is located on Kentucky Lake. A layout is postulated for ten clusters of four reactors each with 2.5-mile spacing between clusters. The plants use natural-draft cooling towers. A transmission system is proposed for delivering the power (48,000 MW) to five load centers. Comparable transmission systems are proposed for the 10-reactor NECs and the 4-reactor dispersed sites delivering power to the same load centers. (auth)

SITING

REFER ALSO TO CITATION(S) 10451, 11471

10651 (ANL-Trans—1042) **Paraseismic precautions for nuclear reactors.** Costes, D. 1971. Translation of Precautions parasismiques pour les reacteurs nucleaires. 34p. Dep. NTIS $4.00.

A paper is presented whose purpose is to present, in a brief manner, the essential facts of the seismological and paraseismological techniques, while showing the derivations and the research problems that lead to construction site choices. (auth)

10652 **Nuclear energy site study.** Smiley, S.H. (Nuclear Regulatory Commission, Washington, DC). *Trans. Am. Nucl. Soc.*; **22**: 302(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

RADIOACTIVE EFFLUENTS

10653 **Turbulent diffusion-typing schemes: a review.** Gifford, F.A. (National Oceanic and Atmospheric Administration, Oak Ridge, TN). *Nucl. Saf.*; **17**: No. 1, 68-86(1976).

Recent environmental concerns have greatly increased the need for turbulent typing schemes in atmospheric diffusion calculations. The standard methods by Brookhaven National Laboratory, Pasquill, the Tennessee Valley Authority, and others are reviewed, and differences, inconsistencies, and modifications to the basic schemes are discussed. Various exceptional flows occur to which existing turbulence typing schemes should not be applied directly: diffusion in near-calm, very stable conditions; diffusion over cities, water bodies, and irregular terrain; and diffusion in building wakes and near highways. Possible modifications to typing schemes in these cases are discussed. In all such exceptional cases, many more observational data are needed before reliable diffusion estimates can be made. (auth)

THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 10448

RESEARCH, TEST, EXPERIMENTAL, ZERO-POWER, AND TRAINING REACTORS AND SUBCRITICAL ASSEMBLIES

REFER ALSO TO CITATION(S) 10688

10654 (HEDL-SA—753) **Nonlinear seismic analysis of a reactor structure with impact between core components.** Hill, R.G. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. Contract AT(45-1)-2170. 22p. (CONF-7509106—1). Dep. NTIS $3.50.

From 4. MASTRAN users[7] colloquim; Lanley Field, Virginia, United States of America [8]USA[9] (9 Sep 1975).

The seismic analysis of the FFTF-PIOTA (Fast Flux Test Facility-Postirradiation Open Test Assembly), subjected to a horizontal DBE (Design Base Earthquake) is presented. The PIOTA is the first in a set of open test assemblies to be designed for the FFTF. Employing the direct method of transient analysis, the governing differential equations describing the motion of the system are set up directly and are implicitly integrated numerically in time. A simple lumped-mass beam model of the FFTF which includes small clearances between core components is used as a "driver" for a fine mesh model of the PIOTA. The nonlinear forces due to the impact of the core components and their effect on the PIOTA are computed. 6 references. (auth)

10655 (HEDL-SA—921) **FTR tag burnup.** Kidman, R.B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1976. 26p. (CONF-750607—52). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

The gas tag burnup changes investigated were limited to the three tags (Kr-78/Kr-80, Xe-126/Xe-129 and Kr-82/Kr-80) currently accepted as being the most desirable. Control rod tag burnup was significantly greater than fuel rod tag burnup. This occurs because control rods stay in the reactor longer and occupy positions of greater low-energy flux. Thus, minimum tag spacings were set by the control rods as 1.079 for Kr-78/Kr-80, 1.189 for Xe-126/Xe-129 and 1.134 for Kr-82/Kr-80.

10656 (HEDL-TI—76004) **FFTF progress highlights, winter 1975—1976.** Weber, S.A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1 Jul 1975. 30p. Dep. NTIS $4.00.

Milestones concerning equipment, reactor components, and testing and operations at the FFTF since July 1, 1975 are highlighted. (JWR)

10657 (HEDL-TME—75-54) **Thermal hydraulic analysis: IDS emergency cooling.** Guzek, J.C. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1975. Contract AT(45-1)-2170. 55p. AT.

Technical adequacy of cooling of the Interim Decay Storage (IDS) facility of the FFTF under emergency conditions of total electrical power loss with only natural circulation air from containment has been evaluated. The hydraulic characteristics of the cooling system are presented in parametric form. Detail temperature distributions are reported for transient and steady-state operations which were calculated for two conditions of decay heat loadings: 100 KW; and 240 KW. Temperatures calculated in principal structural locations of the IDS for all conditions of emergency operation, including non-uniform loading are below respective allowable values. Results indicate that the IDS can be safely cooled by natural circulation during emergency loss of electrical power. (auth)

10658 (HEDL-TME—75-65) **Ex-vessel transfer machine/closed loop ex-vessel machine (EVTM/CLEM) heat transfer testing with a full-scale LMFBR 217-pin electrically heated fuel bundle assembly.** Boasso, C.J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Feb 1976. Contract E(45-1)-2170. vp. AT.

A test facility was designed and fabricated to perform static sodium testing with a modified, electrically heated, 217-pin Fast Flux Test Facility (FFTF) fuel bundle. The fuel bundle was FFTF prototypic with the exception of a 7.5-inch pin extension at the base of the fuel pins and an inlet nozzle prototypic of Clinch River Breeder Reactor (CRBR) design requirements. Data from this facility were required to verify the FFTF Closed Loop Ex-Vessel Machine (CLEM) 10 kW heat removal requirement and to determine the heat transfer design of the CRBR Ex-Vessel Transfer Machine (EVTM).

10659 (SAND—75-0630) **Annular Core Pulse Reactor Upgrade quarterly report, July—September 1975.** (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 47p. Dep. NTIS $5.00.

Progress is summarized in the following task areas: safety, documentation, and compliance; core nuclear design; console development; mechanical design; fuel element design; primary fuel material studies; secondary fuel material studies; driver core fuel element; and fuel motion diagnostic system. A project schedule is included.

10660 (SAND—75-6236) **Design and initial performance of the Sandia Pulsed Reactor-III.** Reuscher, J.A.; Estes, B.F. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 23p. (CONF-760111—3). Dep. NTIS $3.50.

From US;Japan seminar on fast pulse reactors; Tokai, Japan (19 Jan 1976).

The Sandia Pulsed Reactor-III (SPR-III) is a new fast pulsed reactor which has recently undergone initial testing at Sandia Laboratories. SPRaIII is a uranium-10 weight percent molybdenum fuel assembly with a 17.78 cm irradiation cavity similar in design to SPR-II which has been in operation since 1967. The basic SPR-III design utilizes the same split-core configuration which has been proven with SPR-II; however, SPR-III uses external reflectors for control and external bolts to hold the fuel plates together. The core consists of sixteen fuel plates with an inside diameter of 17.78 cm, an outside diameter of 29.72 cm, and a core height of 31.9 cm. The fuel mass is about 227 kg of fully enriched uranium-10 weight percent molybdenum alloy. SPR III has completed the initial series of startup tests which included the critical experiment, zero and low-power tests, and pulse testing. The reactor design and results from the initial testing program are described in this paper. A portion of the startup experiments with SPR-III have been completed and this paper discusses the more important aspects of the initial testing program.

10661 (SAND—75-6238) **Dynamic thermomechanical behavior of the Sandia Pulsed Reactor-III.** Reuscher, J.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 20p. (CONF-760111—2). Dep. NTIS $3.50.

From US;Japan seminar on fast pulse reactors; Tokai, Japan (19 Jan 1976).

The theoretical and measured mechanical behavior of SPR-III during pulse operation is described. The core was instrumented with noncontacting displacement transducers and the oscillations of the fuel plates and support structure were recorded. A method for calculating the fuel stresses using surface oscillations is described. The dynamic, thermal stress results were obtained from a two-dimensional, finite difference analysis which included temperature dependent properties.

10662 (WARD—2171-55) **Resolution of surface defect problem in sensitized type 304 stainless steel pump parts for FFTF.** Cwynar, J.C.; France, L.L.; Ray, W.E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Advanced Reactors Div.). Feb 1976. Contract E(45-1)-2171. 126p. AT.

During the third quarter of CY 1973, evidence of intergranular attack (IGA) was found in the containment tanks and shield plug/support cylinder (SP/SC) assemblies of the FFTF primary pumps, then in manufacture. The indications were confined to Type 304 stainless steel plate and forging material which had been subjected to a long-term anneal at 1150°F to assure the in-service dimensional stability of critical pump components. A fracture mechanics evaluation indicated these cracks to be negligible. However, it could not be established that crack propagation would not occur on external surfaces, particularly in the pressure boundary regions, as a result of stress-corrosion. Only the 4- to 8-inch thick portions of the SP/SC assemblies function as containment boundaries, and since the IGA indications on these portions were few in number, isolated, and very small, it was decided to apply stringent process precautions and use these units without repair. The most feasible repair procedure for the affected portions of the pump tanks was found to be disassembly where required, solution annealing at 1800°F, water quenching, remachining as necessary, and reassembly. An extensive heat treatment study was performed to establish the details of this procedure and determine the metallurgical nature of the reheat-treated components. The repair heat treatment was successfully accomplished for all pump tank parts which has been given the 1150°F anneal. No crack propagation occurred, dimensional stability was such that reworking was unnecessary, and ASTM A393 and A262 Practice A testing showed complete desensitization of the material. (auth)

10663 (WARD—2171-58) **Fast Flux Test Facility quarterly progress report for the period ending August 31, 1975.** (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Advanced Reactors Div.). 1975. Contract E(45-1)-2171. 44p. AT.

Progress is summarized in the areas of reactor engineering, head compartment and shielding design, in-vessel handling machine and instrumentation and control systems and components, plant fluid systems and mechanical components, nuclear safety, and reactor technology.

10664 **Experience with the USAEC reactor sharing program.** Kirkland, R.S. (Georgia Inst. of Tech., Atlanta); Walker, D.M.; Muranaka, R.G. pp 59-60 of In Conference on research, test and training reactors. Charlottesville, VA; Univ. of Virginia (1974).

From Conference on research, test and training reactors; Charlottesville, Virginia, USA (12 Aug 1974).

See CONF-740841—.

10665 **Beryllium damage at the High Flux Isotope Reactor.** Corbett, B.L. (Oak Ridge National Lab., TN). pp 68-69 of In Conference on research, test and training reactors. Charlottesville, VA; Univ. of Virginia (1974).

From Conference on research, test and training reactors; Charlottesville, Virginia, USA (12 Aug 1974).

See CONF-740841—.

10666 **Damage research facilities in the ORNL Bulk Shielding Reactor.** Coltman, R.E. Jr. (Oak Ridge National Lab., TN). pp 95-96 of In Conference on research, test and training reactors. Charlottesville, VA; Univ. of Virginia (1974).

From Conference on research, test and training reactors; Charlottesville, Virginia, USA (12 Aug 1974).

See CONF-740841—.

10667 **Fast-neutron hodoscope at TREAT: development and operation.** De Volpi, A.; Pecina, R.J.; Daly, R.T.; Travis, D.J.; Stewart, R.R.; Rhodes, E.A. (Argonne National Lab., IL). *Nucl. Technol.*; **27**: No. 3, 449-487(Nov 1975).

A description is given of a fast-neutron hodoscope to detect fuel motion within test samples inserted in the center of the Transient Reactor Test Facility (TREAT) reactor core. The fuel motion is induced under simulated hypothetical conditions. The hodoscope system includes components necessary to acquire, store, decode, and process the collected data. (auth)

PLUTONIUM AND ISOTOPE PRODUCTION, CHEMONUCLEAR, MATERIALS TESTING, AND MATERIALS PROCESSING REACTORS

REFER ALSO TO CITATION(S) 10331, 10665, 10709

PROPULSION REACTORS

REFER ALSO TO CITATION(S) 10249

10668 (CONF-750758—(Summ.), pp 119-137) **United States' nuclear merchant ship program: an overview.** Levine, Z. (U.S. Maritime Administration, Washington, DC). Oct 1975.

From Meeting on small nuclear reactors for industrial energy; Oak Ridge, Tennessee, United States of America "USA" (31 Jul 1975).

In Summaries of papers presented at the meeting on small nuclear reactors for industrial energy.

Topics discussed include the Maritime Administration Nuclear Merchant Ship Program, licensing and insurance issues, and marine markets. (JWR)

10669 **Comparison of nuclear versus hydrogen fueled aircraft.** Andrews, D.; Zakanycz, S.; Rolinski, E.J. pp 45-48 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

Nuclear transport aircraft appear feasible in the size range of this study and require additional in-depth studies and analyses. The hydrogen economy appears to be dependent upon an inexpensive source of non-fossil energy (e.g., nuclear, solar, wind, or geothermal). (auth)

NUCLEAR SHIPS LICENSING AND REGULATION

10670 (COM—75-10513) **Issues of financial protection in nuclear merchant ship operations. Final report, June 1974—January 1975.** Murphy, A.W. (Atomic Industrial Forum, Inc., New York (USA)). 27 Mar 1975. Contract MA-4-37122. 95p. NTIS $4.75.

Adequate financial protection against liability for builders and operators of nuclear powered merchant ships is a significant element in establishment of a viable nuclear merchant ship program. Questions of liability, insurance and indemnity as they might affect the construction and operation of nuclear ships and requirements of a legislative package which would assure adequate protection of the public in the remote event of a nuclear ship accident are examined. (GRA)

REACTOR SAFETY

REFER ALSO TO CITATION(S) 10593

10671 (ANCR—1236) **Experiment data report for semiscale Mod-1 tests S-02-9 and S-02-9A (blowdown heat transfer tests).** (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Jan 1976. Contract E(10-1)-1375. 142p. Dep. NTIS $7.75.

Recorded test data are presented for Tests S-02-9 and S-02-9A of the Semiscale Mod-1 blowdown heat transfer test series. These tests are among several Semiscale Mod-1 experiments conducted to investigate the thermal and hydraulic phenomena accompanying a hypothesized loss-of-coolant accident in a water-cooled nuclear reactor system and to provide data for the assessment of the Loss-of-Fluid Test (LOFT) design basis. Tests S-02-9 and S-02-9A were conducted from initial cold leg fluid temperatures of 542 and 544°F, respectively, and initial pressures of 2,253 and 2,263 psia, respectively. A simulated double-ended offset shear cold leg break was used to investigate the system response to a depressurization transient with full core power (1.6 MW). An electrically heated core was used in the pressure vessel to simulate the effects of a nuclear core. System flow was set to achieve full core temperature differential (66°F). The flow resistance of the intact loop was based on core area scaling. During system depressurization, core power was reduced from the initial level of 1.6 MW in such a manner as to simulate the surface heat flux response of the LOFT nuclear fuel rods until such time that departure from nucleate boiling occurs. Both tests were conducted with a flat radial power profile. Blowdown to the pressure suppression system was accompanied by simulated emergency core cooling injection into both the intact and broken loops. However, pressure suppression system coolant spray was not used. (auth)

10672 (ANCR—1262) **Quarterly technical report on water reactor safety programs sponsored by the Nuclear Regulatory Commission's Division of Reactor Safety Research, April—June 1975.** (Idaho National Engineering Lab., Idaho Falls (USA)). Nov 1975. Contract E(10-1)-1375. 226p. Dep. NTIS $7.60.

The current water reactor safety activities of ANC are accomplished in four programs. The Semiscale Program consists of small-scale nonnuclear thermal-hydraulic experiments for the generation of experimental data that can be applied to analytical models describing loss-of-coolant accident (LOCA) phenomena in water-cooled nuclear power plants. Emphasis is placed on acquiring system effects data from integral tests that characterize the most significant thermal-hydraulic phenomena during the depressurization (blowdown) and emergency cooling phase of a LOCA. The LOFT Program provides test data to support: (a) assessment and improvement of the analytical methods utilized for predicting the behavior of pressurized water reactors (PWR) under LOCA conditions; (b) evaluation of the performance of PWR engineered safety features (ESF), particularly the emergency core cooling system (ECCS); and (c) assessment of the quantitative margins of safety inherent in the performance of these safety features. The Thermal Fuels Behavior Program is a program designed to provide information on the behavior of reactor fuels under normal, off-normal, and accident conditions. The experimental portion is concentrated on testing of single fuel rods and fuel rod clusters under power-cooling-mismatch (PCM), loss-of-coolant, and reactivity initiated accident conditions. The Reactor Behavior Program encompasses the analytical aspects of predicting the response of nuclear power reactors under normal, abnormal, and accident conditions. The status of each program is reported. (auth)

10673 (ANCR—1272) **Characteristics, stability, and short-wavelength phenomena in two-phase flow equation systems.** Ramshaw, J.D.; Trapp, J.A. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1976. Contract E(10-1)-1375. 22p. Dep. NTIS $5.00.

The occurrence and significance of complex characteristics in two-phase flow equation systems are clarified by a detailed analysis of separated two-phase flow between two parallel plates. The basic system of one-dimensional, two-phase flow equations for this problem possesses complex characteristics, exhibits unbounded instabilities in the short-wavelength limit, and constitutes an improperly posed initial value problem. These difficulties have led some workers to propose major modifications to the basic equation system. The relatively minor modification of introducing surface tension is shown to be sufficient to render the characteristics real, to stabilize short-wavelength disturbances, and to produce a properly posed problem. For a given value of the surface tension, the basic equation system thus modified is shown to predict correctly the evolution of small-amplitude disturbances having wavelengths long compared to the plate spacing. A formula is given for the artificial surface tension necessary to stabilize wavelengths of the order of the mesh spacing in a finite-difference numerical calculation. A brief discussion is given concerning the expected behavior of surface tension as compared to viscosity in the nonlinear regime. The general relationship between characteristics and stability is discussed in Appendix A.

10674 (ANCR—1280) **Effects of burnup on fuel failure. Power burst tests on fuel rods with 13,000 and 32,000 MWd/MTU burnup.** Miller, R.W. (Idaho National Engineering Lab., Idaho Falls (USA)). Jan 1976. Contract E(10-1)-1375. 39p. Dep. NTIS $5.00.

Results are presented from preliminary tests designed to investigate the behavior of preirradiated fuel rods under reactivity initiated accident (RIA) conditions. The tests were conducted in 1970 as part of the SPERT/Capsule Driver Core (CDC) program. The report was intended to be published in a series of Idaho Nuclear Corporation Interim Technical Reports (IN-ITRs); however, the CDC program was terminated before the report could be released. In September 1975, the Nuclear Regulatory Commission concluded that the data contained in the report could be a valuable reference in planning future water reactor safety program tests and requested its release.

10675 (ANL—76-5) **Radiative cooling of a voided subassembly.** Chan, S.H.; Condiff, D.W.; Grolmes, M.A. (Argonne National Lab., Ill. (USA)). Jan 1976. Contract W-31-109-Eng-38. 18p. AT.

A treatment is formulated for surface-to-surface radiative heat exchange between fuel pins and between pins and duct wall of a nuclear-reactor subassembly voided of coolant. Specific attention is given to the case of equal power generation in each pin with uniform duct-wall temperature. Detailed temperature profiles and heat flux values are reported for hexagonal-ring subassemblies ranging in size from one to nine rings. It is found that a duct wall at 1153°K can cool by radiation even a nine-ring voided subassembly operating at a power level of up to 0.54 kW/ft per pin or 5.4 percent of full power without fuel slumping or melting, or that a seven-pin assembly can be cooled by radiation up to a power of 7.3 kW/ft.

10676 (BNL—50460) **HTGR Safety Evaluation Division quarterly report, April 1, 1975—June 30, 1975.** (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. Contract E(30-1)-16. 30p. Dep. NTIS $7.00.

Information is presented concerning fission product release and transport, primary coolant impurities, rapid graphite oxidation, structural evaluation, materials, instrumentation and monitoring, and phenomena modeling and systems analysis. (DCC)

10677 (BNL—50467) **Advanced thermohydraulic transient code for LMFBRs. Quarterly progress report, July 1—September 30, 1975.** Agrawal, A.K. (Brookhaven National Lab., Upton, N.Y. (USA)). Oct 1975. Contract E(30-1)-16. 100p. Dep. NTIS $6.50.

The objectives and the accomplishments of the SSC research program are described. Briefly, the SSC code is being developed to analyze (1) the consequences of a massive pipe rupture in the primary heat transport system, and (2) the long-term after-heat removal capability from the "loop" type liquid metal cooled fast breeder reactors (LMFBR). In addition, at least some of the "level 2" transients may be analyzed. All of these events assume that the plant protection system is functioning. Pre- or post-hypothetical core disruptive accidents (i.e., off-normal incidences with assumed failure of the reactor scram) are not considered, at least at present, in the scope of the SSC effort. The progress made during this quarter is reported under the following five categories: (1) In-vessel Modeling, (2) Primary Loop Modeling, (3) Intermediate Loop Modeling, (4) Tertiary Loop Modeling, and (5) Code Development. Much of the modeling describing the single-phase coolant dynamics in various regions of the vessel and the heat transfer in fuel rods and its associated structures has been completed. Work on coding these models was initiated. The steady state and transient models for solving the conservation equations for sodium flow in the primary loop have been developed. A test program was written and results for simplified test cases are included. (auth)

10678 (CENPD—107(Suppl.4)) **ATWS model modifications to CESEC.** (Combustion Engineering, Inc., Windsor, Conn. (USA)). Dec 1975. 79p. Combustion Engineering, Inc., Windsor, CT.

Descriptions are presented of all significant modifications to the CESEC computer code which have been made since September, 1974, for application to analysis of ATWS events in a C—E Nuclear Steam Supply System. These modifications include reformulation of the analytical descriptions of the mass and energy conservation in the reactor coolant in both the reactor coolant system loops and the pressurizer; improvement of the conduction, convection, and boiling heat transfer models; improvement of the Doppler and void reactivity feedback models; and improvement of the steam generator dryout model. The report also includes descriptions of the verification of the CESEC reactivity feedback model using three-dimensional neutron diffusion calculations and specification of fuel damage criteria. Also included are modifications of certain responses to NRC questions concerning C—E's ATWS evaluation methods previously submitted by C—E and

responses to all NRC questions not previously submitted. 15 references. (auth)

10679 (CENPD—158) **Anticipated transients without reactor trip.** (Combustion Engineering, Inc., Windsor, Conn. (USA)). 1974. 149p. Combustion Engineering, Inc., Windsor, CT.

The analytical methods, computer codes, transients selected, and results of transients analyzed for Combustion Engineering PWR systems are presented. (JWR)

10680 (CENPD—213) **Application of FLECHT reflood heat transfer coefficients to C-E's 16 x 16 fuel bundles.** Holderness, J.H. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Jan 1976. 111p. Combustion Engineering, Inc., Windsor, CT.

NRC has approved a FLECHT based reflood heat transfer correlation (designated MOD-1C) for use on the C—E 14 x 14 fuel assembly. A procedure for applying the MOD-1C correlation to the C—E 16 x 16 fuel assembly is proposed. The procedure applies a correction factor to the MOD-1C correlation. This correction factor accounts for the geometric differences between the 14 x 14 and 16 x 16 fuel assemblies. Comparison with experimental data corroborates the applicability of the correction method. Thus, C—E requests approval to use the MOD-1C correlation with the geometric correction factor in ECCS analyses on plants having 16 x 16 fuel assemblies. A computer program called THERM is described which presents a physical model of the reflood heat transfer process. This program was employed to establish the significant parameters involved in the geometric correction factor. Thus, the acceptability of the correction factor is based on the comparisons with experimental data rather than on the THERM program. (auth)

10681 (COO—2554-3) **Heat transfer from bubbling pools. Progress report, July 1, 1975—October 1, 1975.** Bankoff, S.G.; Luk, A. (Northwestern Univ., Evanston, Ill. (USA)). 1975. Contract AT(11-1)-2554. 25p. Dep. NTIS $3.50.

It is shown that the heat transfer characteristics of volume-heated boiling pools can be successfully modeled by non-boiling pools with internal gas injection. The strong influence of spatial distribution of bubble sites is relevant to estimates of boiling fuel attack on gas-releasing sacrificial materials. (auth)

10682 (CRBRP-PMC—76-01) **Safety and environmental impact of liquid metal fast breeder reactors.** Buhl, A.R.; Graham, J. (Clinch River Breeder Reactor Plant Project Office, Oak Ridge, Tenn. (USA)). Jan 1976. 14p. AT.

Liquid metal fast breeder reactors are a necessary component in the national energy program planned for introduction as commercial power generating stations in the mid-1980s. The safety and environmental impact of liquid fast breeder reactors is treated by considering principally the matters of most concern to the critics of the program in areas of safety and environmental impact. Areas of major concern, such as the use of sodium and its potential loss from the system as a coolant and the potential for critical reconfiguration accidents involving an energy release or damage to the core, are considered. Other areas of concern such as plutonium toxicity and the potential for inadvertent or malicious release of plutonium, waste management and waste heat rejection, and accidental releases of radioactivity are also covered. In each case, the situation is reviewed and the conclusion drawn that the LMFBR is a safe and environmentally attractive method of power generation. (auth)

10683 (EUR—5394e) **European Community light water reactor safety research projects, experimental issue.** (Commission of the European Communities, Brussels (Belgium)). 1975. 559p. (In English and French). Dep. NTIS (US Sales Only) $13.50.

Brief summaries of LWR safety research projects conducted by members of the European community are presented. The research includes blowdown and emergency core cooling, core meltdown, external hazards, power transients, materials and mechanical problems, quality assurance, environmental protection, fuel cycle, and other areas. (JWR)

10684 (GA-A—13617(Vol.3)) **HTGR accident initiation and progression analysis status report. Volume III. Preliminary results (including design options).** (General Atomic Co., San Diego, Calif. (USA)). Nov 1975. Contract E(04-3)-167. vp. Dep. NTIS $7.60.

The results of a preliminary risk analysis, which was completed in February 1975, and represents the scoping phase of the AIPA program of the systematic probabilistic study of HTGR safety are presented. The preliminary phase was expected to provide several benefits: (1) establish a framework for the ranking of HTGR abnormal event sequences with respect to safety as an aid in the selection of future efforts, (2) provide quantitative data for the identification of R and D tasks, (3) provide bases for the selection of systems suitable for the studies of economic aspects of alternative design options for the safety-related systems, and (4) provide insights as to which aspects of the risk analysis need to be emphasized in the future to achieve necessary maturing of the probabilistic methodology. Seventeen initiating events were chosen and evaluated, these being representative of the complete spectrum of classes of potential radioactive sources in the plant and having potentially the highest probabilities of release within each class. While this ensured a considerable degree of completeness, it also resulted in evaluations of many events with insignificant risk, which are found in the text (e.g., an improbable event of release from a crushed small neutron source capsule). The most immediate application of preliminary analysis results was to determine which initiating events deserved a more detailed examination. (auth)

10685 (GA-A—13617(Vol.4)) **HTGR accident initiation and progression analysis status report. Volume IV. Phase I analyses and R and D recommendations.** Deremer, R.K.; Fleming, K.N.; Hannaman, G.W.; Houghton, W.J.; Landoni, J.A.; Pfremmer, R.D.; Raabe, P.H.; Silady, F.A.; Vrouwes, J.H. (General Atomic Co., San Diego, Calif. (USA)). Dec 1975. Contract E(04-3)-167. vp. Dep. NTIS $7.60.

Included are detailed risk assessments of reheater leaks, loss of offsite power, and earthquakes. Research and development guidelines from AIPA are discussed.

10686 (GA-A—13727) **Containment atmospheric response (CAR) scoping study.** Del Bene, J.V.; Deremer, R.K.; Landoni, J.A. (General Atomic Co., San Diego, Calif. (USA)). Dec 1975. Contract E(04-3)-167. vp. Dep. NTIS $4.00.

The primary objectives of the Containment Atmospheric Response (CAR) subtask are to identify and evaluate thermodynamic phenomena occurring in the containment atmosphere during postulated gas-cooled reactor depressurization events that may affect the release of fission products to the environment. The release of fission products to the environment can be altered if the containment function fails, if the amount of plateout in the containment is changed or if the performance of the containment atmospheric cleanup system is impaired. A knowledge of the blowdown phenomena can also provide guidelines for locating reactor shutdown equipment and establishing requirements for the CACS. (auth)

10687 (GA-A—13779) **GCR Safety Program. Quarterly progress report for the period ending December 31, 1975.** (General Atomic Co., San Diego, Calif. (USA)). 31 Jan 1976. Contract E(04-3)-167. 29p. Dep. NTIS $4.00.

The program covers development of safety and safety-related studies to better understand and more accurately define safety characteristics and safety margins of GCRs under postulated accident conditions. The work reported includes core seismic studies, high-temperature gas-cooled reactor (HTGR) accident initiation and progression analysis, the setting up of a reliability data bank, safety liaison with RRD-selected contractors, and safety research on core-released radioactivity and containment atmosphere response during postulated accident situations. (auth)

10688 (HEDL-SA—909) **FFTF transient overpower accident: a perspective.** Waltar, A.E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. 34p. (CONF-750607—43). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

A brief reflection on the current understanding of the unprotected transient overpower accident is presented and an attempt to place it into perspective with regard to the overall question of the FFTF core energetics. (auth)

10689 (ISD—166) **Limit load analysis of thick-walled concrete structures. A finite element approach to fracture.** Argyris, J.H.; Faust, G.; Willam, K.J. (Stuttgart Univ. (TH) (F.R. Germany). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen). 1975. 20p. INIS.

32 figs.; 21 refs.

The interaction of constitutive modeling and finite element solution techniques for limit load prediction of concrete structures is discussed. On the constitutive side, an engineering model of concrete fracture is developed in which the Mohr-Coulomb criterion is augmented by tension cut-off to described incipient failure. Upon intersection with the stress path the failure surface collapses for brittle behavior according to one of three softening rules, no-tension, no-cohesion, and no-friction. The stress transfer accompanying the energy dissipation during local failure is modelled by several fracture rules which are examined with regard to ultimate load prediction. On the numerical side the effect of finite element idealization is studied first as far as ultimate load convergence is concerned. Subsequently, incremental tangential

and initial load techniques are compared together with the effect of step size. Limit load analyses of a thick-walled concrete ring and a lined concrete reactor closure are presented. (DE)

10690 (JAPFNR—200) **Preliminary results of gas injection into sodium flowing in a 37-pin bundle.** Haga, K.; Kikuchi, Y.; Daigo, Y. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). Sep 1975. 8p. (CONF-751081—3; N—943-75-04). Dep. NTIS (US Sales Only) $3.50.

From 6. liquid metal boiling working group meeting; Risley, United Kingdom of Great Britain and Northern Ireland [8]UK[9] (1 Oct 1975).

Work performed under United States—Japanese Fast Reactor Exchange Program.

Out-of-pile experiments were conducted to evaluate the thermal and hydrodynamic effects due to gas injection into sodium flowing in a 37-pin bundle, which consisted of a central gas-injection pin, seven electrically heated pins and other dummy pins. Thermocouples were installed on the cladding of heated pins. The first series of experiments were carried out without gas injection to establish base cases and to evaluate the effect of mixing due to spacer wires. The experimental results agreed well with the predictions by the NORMAL code which considers the effect of mixing due to spacer wires. The second series of experiments were conducted by injecting argon gas transiently or continuously through a small nozzle (0.2 approximately 0.3 mm in diameter) of the gas-injection pin. In the transient injection experiment rapid temperature rises due to gas blanketing were observed on the surfaces of the heated pins at the axial position where gas was injected. In the continuous injection experiments, however, the measured wall temperature rises were small and well within tolerable limits. (auth)

10691 (JAPFNR—201) **Acoustic noise with sodium boiling in a seven-pin bundle.** Kikuchi, Y.; Daigo, Y.; Haga, K. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). Aug 1975. 9p. (CONF-751081—1; N—943-75-03). Dep. NTIS (US Sales Only) $3.50.

From 6. liquid metal boiling working group meeting; Risley, United Kingdom of Great Britain and Northern Ireland [8]UK[9] (1 Oct 1975).

Work performed under United States—Japanese Fast Reactor Exchange Program.

The acoustic noises associated with sodium boiling in a seven-pin bundle, six central channels of which were blocked, are discussed. The acoustic intensity first increased with rise in the heat flux, and after attaining a maximum, decreased somewhat to remain more or less constant thereafter. At the final upstream voiding which resulted in the dryout, however, the acoustic intensity increased sharply. The frequency spectrum did not change markedly during boiling. Distinct peaks observed in the high frequency range for all the measurements could well be related to the characteristics of the resonances of the experimental system which is not the waveguide, but the test section and/or the expansion tank. On the other hand, the peak observed at the low frequency was due to the repetition of bubble formation and collapse. (auth)

10692 (JAPFNR—202) **Local temperature rise due to a 6-channel blockage in a 7-pin bundle.** Daigo, Y.; Haga, K.; Ohtsubo, A.; Kikuchi, Y. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). Sep 1975. 8p. (CONF-751081—2; N—943-75-05). Dep. NTIS (US Sales Only) $3.50.

From 6. liquid metal boiling working group meeting; Risley, United Kingdom of Great Britain and Northern Ireland [8]UK[9] (1 Oct 1975).

Work performed under United States—Japanese Fast Reactor Exchange Program.

An experimental study was performed of local temperature rises due to a non-heat-generating blockage in an electrically heated 7-pin bundle. Each pin was 6.5 mm in diameter and had a 450 mm heated length. The pitch-to-diameter ratio (P/D) was 1.22. The bundle was inserted in a hexagonal duct. The central six channels in the bundle were blocked by a 0.5 mm thick stainless steel plate at 350 mm downstream from the start of the heated section. The temperature distributions were measured by the thermocouples which were mostly located downstream from the blockage. The experimental conditions were as follows. Coolant velocity: 0.37 approximately 5.00 m/s, Linear heat rate: 8.5 approximately 127.2 w/cm, and Inlet coolant temperature: 298 approximately 296°C. The hottest surface temperature of the central pin was observed immediately downstream from the blockage. The measured temperature rise was approximately two thirds of the predicted value by the LOCK code, in which the presence of a stagnation behind the blockage was assumed. When applying the experimental results to reactor conditions, the temperature rise due to a 6-channel blockage is considered to be less than 130°C.

10693 (LA—6180-SR) **Status of CHAP: composite HTGR analysis program.** Secker, P.A.; Gilbert, J.S. (Los Alamos Scientific Lab., N.Mex. (USA)). Dec 1975. Contract W-7405-ENG-36. 51p. Dep. NTIS $5.50.

Development of an HTGR accident simulation program is in progress for the prediction of the overall HTGR plant transient response to various initiating events. The status of the digital computer program named CHAP (Composite HTGR Analysis Program) as of June 30, 1975, is given. The philosophy, structure, and capabilities of the CHAP code are discussed. Mathematical descriptions are given for those HTGR components that have been modeled. Component model validation and evaluation using auxiliary analysis codes are also discussed.

10694 (LA-UR—74-243) **Proposal for computer investigation of LMFBR core meltdown accidents.** Boudreau, J.E.; Harlow, F.H.; Reed, W.H.; Barnes, J.F. (Los Alamos Scientific Lab., N.Mex. (USA)). 1974. Contract W-7405-eng-36. 59p. Dep. NTIS $4.50.

The environmental consequences of an LMFBR accident involving breach of containment are so severe that such accidents must not be allowed to happen. Present methods for analyzing hypothetical core disruptive accidents like a loss of flow with failure to scram cannot show conclusively that such accidents do not lead to a rupture of the pressure vessel. A major deficiency of present methods is their inability to follow large motions of a molten LMFBR core. Such motions may lead to a secondary supercritical configuration with a subsequent energy release that is sufficient to rupture the pressure vessel. The Los Alamos Scientific Laboratory proposes to develop a computer program for describing the dynamics of hypothetical accidents. This computer program will utilize implicit Eulerian fluid dynamics methods coupled with a time-dependent transport theory description of the neutronic behavior. This program will be capable of following core motions until a stable coolable configuration is reached. Survey calculations of reactor accidents with a variety of initiating events will be performed for reactors under current design to assess the safety of such reactors. (auth)

10695 (LBL—4437) **Review of the American Physical Society light water reactor safety study.** Budnitz, R.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 4p. (CONF-751116—25). Dep. NTIS $3.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

The issue of light-water reactor (LWR) safety has been the subject of a part-time, year-long study sponsored by the American Physical Society and supported by the National Science Foundation and the former Atomic Energy Commission. The 1974-1975 study produced a Report by the Study Group to the Society. The Report's "Summary of Conclusions and Major Recommendations" section is presented. (auth)

10696 (NEDO—20566(Vol.1)) **General Electric Company analytical model for loss-of-coolant analysis in accordance with 10CFR50 appendix K. Volume I.** (General Electric Co., San Jose, Calif. (USA). Nuclear Energy Div.). Jan 1976. 361p. General Electric Co., San Jose, CA.

Documentation for General Electric Company analytical models for predicting BWR response to postulated loss-of-coolant accidents is presented. (JWR)

10697 (NEDO—20566(Vol.2)) **General Electric Company analytical model for loss-of-coolant analysis in accordance with 10CFR50 appendix K. Volume II.** (General Electric Co., San Jose, Calif. (USA). Nuclear Energy Div.). Jan 1976. 381p. General Electric Co., San Jose, CA.

Documentation for the General Electric Evaluation Model is presented. Computer codes and numerical methods common to the codes are described. It is shown how GE BWR's conform to the Acceptance Criteria of 10CFR50.46. (JWR)

10698 (ORNL—5102) **Zirconium metal-water oxidation kinetics. I. Thermometry.** Cathcart, J.V.; McElroy, D.L.; Pawel, R.E.; Perkins, R.A.; Williams, R.K.; Yurek, G.J. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 69p. Dep. NTIS $6.00.

A description is given of the thermometry techniques used in the Zirconium Metal—Water Oxidation Kinetics Program. Temperature measurements in the range 900 to 1500°C are made in three experimental systems: two oxidation apparatuses and the annealing furnace used in a corollary study of the diffusion of oxygen in β-Zircaloy. Carefully calibrated Pt vs Pt—10 percent Rh thermocouples are employed in all three apparatuses, while a Pt—6 percent Rh vs Pt— 30 percent Rh thermocouple and an optical pyrometer are used in addition in the annealing furnace. Features of the experimental systems pertaining to thermocouple installation, temperature control, emf measurements, etc. are described,

and potential temperature-measurement error sources are discussed in detail. The accuracy of the temperature measurements is analyzed.

10699 (ORNL-NSIC—120) **Hydrogen considerations in light-water power reactors.** Keilholtz, G.W. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 355p. Dep. NTIS $15.00.

A critical review of the literature now available on hydrogen considerations in light-water power reactors (LWRs) and a bibliography of that literature are presented. The subject matter includes mechanisms for the generation of hydrogen-oxygen mixtures, a description of the fundamental properties of such mixtures, and their spontaneous ignition in both static and dynamic systems. The limits for hydrogen flammability and flame propagation are examined in terms of the effects of pressure, temperature, and additives; the emphasis is on the effects of steam and water vapor. The containment systems for pressurized-water reactors (PWRs) and boiling-water reactors (BWRs) are compared, and methods to control hydrogen and oxygen under the conditions of both normal operation and postulated accidents are reviewed. It is concluded that hydrogen can be controlled so that serious complications from the production of hydrogen will not occur. The bibliography contains abstracts from the computerized files of the Nuclear Safety Information Center. Key-word, author, and permuted-title indexes are provided. The bibliography includes responses to questions asked by the U. S. Nuclear Regulatory Commission (NRC) which relate to hydrogen, as well as information on normal operations and postulated accidents including generation of hydrogen from core sprays. Other topics included in the ten sections of the bibliography are metal-water reactions, containment atmosphere, radiolytic gas, and recombiners.

10700 (ORNL-NSIC—123) **Nuclear power: accident probabilities, risks, and benefits. A bibliography.** (483 2000). Feb 1976. Contract W-7405-eng-26. 138p. Dep. NTIS $12.00.

This report is a selected listing of 396 documents pertaining to nuclear accident probability and nuclear risk. Because of the attention focused on these concepts by the recent (August 1974) publication of the draft of WASH-1400, "Reactor Safety Study," it is intended that this bibliography make conveniently available the existence of relevant literature on these concepts. Such an awareness will enhance an understanding of probability and risk as applied to nuclear power plants and is essential to their further development and/or application. This bibliography includes first a listing of the selected documents with abstracts and keywords, followed by three indexes: (1) keyword, (2) author, and (3) permuted title.

10701 (ORNL-TM—5155) **Monthly progress report for October 1975 for the HTGR safety studies for the Division of Technical Review, U.S. Nuclear Regulatory Commission.** Sanders, J.P. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 5p. Dep. NTIS $4.00.

10702 (ORNL/TM—5263) **Monthly highlights for Office of Nuclear Regulatory Research Programs at Oak Ridge National Laboratory.** Fee, G.G. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 25p. Dep. NTIS $5.00.

Brief highlights are presented for the following programs: heavy section steel technology, fission product beta and gamma energy release, LOCA release from LWR fuel, multirod burst tests, NSIC, PWR blowdown heat transfer-separate effects, zircaloy fuel cladding collapse, zirconium metal-water oxidation kinetics, aerosol release from LMFBR fuel, HTGR safety analysis and research, and design criteria for piping and nozzles. (JWR)

10703 (ORNL/TM—5268) **Monthly progress report for January 1976 for the HTGR safety studies for the Division of Systems Safety, U.S. Nuclear Regulatory Commission.** Sanders, J.P. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 11p. Dep. NTIS $4.50.

Progress is reported in the areas of thermal analysis of HTGR systems, axial mode spacing affects in flow distribution calculations, and performance calculations for the core auxiliary heat exchanger.

10704 (ORNL/TM—5279) **Quarterly progress report on the creepdown and collapse of Zircaloy fuel cladding program sponsored by the NRC Division of Reactor Safety Research for October—December 1975.** Hobson, D.O. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 11p. Dep. NTIS $3.50.

The creepdown and collapse study on Zircaloy fuel cladding is concerned with the deformation behavior of cladding under normal and near-normal reactor operating conditions. Progress is reported on two phases of the program: (1) collapse testing and (2) development and fabrication of deformation-monitoring equipment. Sufficient collapse testing has been done to begin the analysis of the test data. It is apparent that all three of the independent variables used in this study (pellet-to-pellet gap, pellet-to-cladding gap, and temperature) play major roles in the collapse phenomenon. Tentative trends are presented but they constitute an insufficient basis for the quantitative formulation of a collapse model at this time. The instrumentation for deformation monitoring has been developed and provision has been made for automatic control of the data gathering system and for protection of the monitoring coils from damage caused by collapse of the specimen tube.

10705 (REG/G—1.97(12-75)) **Instrumentation for light-water-cooled nuclear power plants to assess plant conditions during and following an accident.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Standards Development). Dec 1975. 4p. NUREG.

10706 (SAND—75-0567) **Experimental fast reactor safety research program. Quarterly report, July—September 1975.** (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 76p. Dep. NTIS $9.00.

Research progress is reported for the following tasks: prompt burst excursion experiment, debris bed studies, material motion detection, molten fuel pool studies, and equation-of-state studies of reactor fuels. (JWR)

10707 (SAND—75-6102) **Post-accident heat removal "information exchange".** Plein, H.G.; Carlson, G.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 13p. (CONF-751140—2). Dep. NTIS $3.50.

From Meeting on post-accident heat removal information exchange; Albuquerque, New Mexico, USA (13 Nov 1975).

The in-core molten pool experiments are designed to produce a pool of fission heated temperature and flow patterns of such pools, and evaluate the barrier melt-through potential of the molten UO_2. The first experiments, to be conducted this fiscal year in the Annular Core Pulse Reactor, will be uncomplicated and multiply-contained to prove containment design and to provide initial information on fission heated molten pool characteristics. Concurrent with the in-core experiments, high temperature ultrasonic techniques are being developed to measure UO_2 temperatures up to and above the melting point for use in later more definitive experiments scheduled for FY77. (auth)

10708 (SL-TR—1(Rev.1)) **Quality assurance program.** (Sargent and Lundy, Chicago, Ill. (USA)). 30 Jan 1976. 95p. Sargent and Lundy, Chicago, IL.

Management commitments and policies on quality assurance are stated. Quality assurance requirements are established for the design and procurement phases of construction of a nuclear power plant. This report has been prepared in accordance with the guidance and requirements of Regulatory Guide 1.70.6, Additional Information, Quality Assurance During Design and Construction. The criteria in 10CFR50 Appendix B, Quality Assurance Criteria for Nuclear Power Plants have been individually addressed as each will or may be applicable on a specific project. (auth)

10709 (UNI-SA—21) **Lecture notes: meantime to failure analysis.** Hanlen, R.C. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 23 Jan 1976. Contract AT(45-1)-1857. 12p. Dep. NTIS $3.50.

A method is presented which affects the Quality Assurance Engineer's place in management decision making by giving him a working parameter to base sound engineering and management decisions. The theory used in Reliability Engineering to determine the mean-time-to-failure of a component or system is reviewed. The method presented derives the probability density function for the parameter of the exponential distribution. The exponential distribution is commonly used by industry to determine the reliability of a component or system when the failure rate is assumed to be constant. Some examples of N Reactor performance data are used. To be specific: The ball system data with 4.9×10^6 unit hours of service and 7 individual failures indicates a demonstrated 98.8 percent reliability at a 95 percent confidence level for a 12 month mission period, and the diesel starts data with 7.2×10^5 unit hours of service and 1 failure indicates a demonstrated 94.4 percent reliability at a 95 percent confidence level for a 12 month mission period. (auth)

10710 (WCAP—8651) **FLECHT low flooding rate cosine test series data report.** Rosal, E.R.; Hochreiter, L.E.; McGuire, M.F.; Krepinevich, M.C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1975. Contract AT(49-24)-0178. 498p. Dep. NTIS $12.50.

The FLECHT Low Flooding Rate Tests were conducted in an improved original FLECHT Test Facility to provide heat transfer coefficient and entrainment data at forced flooding rates of 1 in./sec and below. In addition these tests were performed to supplement parametric effects studied in the original FLECHT program, provide data for reflood model development, repeat original FLECHT tests with new instrumentation and data processing techniques, and to provide data to establish test repeatability. These tests examined the effects of low initial clad temperature, variable stepped and continuously variable flooding rates, housing heat release, run peak power, constant low flooding rates, coolant subcooling, hot and cold channel entrainment, and bundle stored and generated power. Data obtained in sixty four runs which met the test specifications are reported, and include rod clad temperatures, turn around and quench times, heat transfer coefficients, inlet flooding rates, overall mass balances, differential pressures and calculated void fractions in the test section, thimble wall and steam temperatures, exhaust steam and liquid carryover rates, and housing total and rate of heat release. (auth)

10711 (WCAP—8692) **Fuel rod bowing.** Reavis, J.R.; Leech, W.J.; Cadek, F.F.; Cerni, S.; Hellman, J.M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1975. 130p. Westinghouse Electric Corp., Pittsburgh, PA.

The purpose of this investigation was to quantify the extent of fuel rod bowing in Westinghouse pressurized water reactors and to assess the effects of fuel rod bowing on plant safety and reliability. An empirical bow correlation was developed based on data from irradiated assemblies. Analyses conducted with these conservative empirical predictions show that: (1) generically identified DNBR margins are adequate to offset DNBR reductions due to rod bow, (2) the present design practice of increasing the highest calculated core peaking factor is sufficient to account for all deviations, including the effects of rod bow, and (3) fretting and corrosion of bowed rods are negligible. These conclusions indicate that fuel rod bowing results in no impact on plant safety or reliability. (auth)

10712 **Monitoring circuit for reactor safety systems.** Keefe, D.J. (to U.S. Energy Research and Development Administration). US Patent Application 555,330. Filed date 4 Mar 1975. 8p.

The ratio between the output signals of a pair of reactor safety channels is monitored. When the ratio falls outside of a predetermined range, it indicates that one or more of the safety channels has malfunctioned. (auth)

10713 (FRRSR—10) **Metrology of two-phase flow: different methods.** Delhaye, J.M.; Galaup, J.P.; Reocreux, M.; Ricque, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Transfert et Conversion d'Energie). Sep 1973. Translation of CEA-R—4457. 114p. Dep. NTIS $5.50.

Nine papers are presented concerning different methods of measuring two-phase flow. Some of the methods and equipment discussed include: radiation absorption, electromagnetic flowmeter, anemometry, resistance probes, phase indicating microthermocouples, optical probes, sampling methods, and pitot tubes. (DCC)

10714 **EPRI program in water reactor safety.** Loewenstein, W.B.; Gelhaus, F.; Gopalakrishnan, A. (Electric Power Research Inst., Palo Alto, CA). *Proc. Am. Power Conf.*; **37**: 129-136(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

The basis for EPRI's water reactor safety program is twofold. First is compilation and development of fundamental background data necessary for quantified light-water reactor (LWR) safety assurance appraisals. Second is development of realistic and experimentally bench-marked analytical procedures. The results are expected either to confirm the safety margins in current operating parameters, and to identify overly conservative controls, or, in some cases, to provide a basis for improvements to further minimize uncertainties in expected performance. Achievement of these objectives requires the synthesis of related current and projected experimental-analytical projects toward establishment of an experimentally-based analysis for the assurance of safety for LWRs. (auth)

10715 **Numerical simulation of flow in an unwrapped downcomer.** Butler, T.D.; Romero, N.C. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.*; **22**: 260-261(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10716 **Discharge flow with two-dimensional two-fluid model analysis.** Hirt, C.W.; Rivard, W.C. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.*; **22**: 261-263(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10717 **Thermal nonequilibrium effects in the drift flux model of two-phase flow.** Ishii, M. (Argonne National Lab., IL); Jones, O.; Zuber, N. *Trans. Am. Nucl. Soc.*; **22**: 263-264(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10718 **Small-break analysis models in the RELAP4 computer code.** Slater, C.E. (Intermountain Technologies, Idaho Fall, ID); Katsma, K.R.; Fischer, S.R.; Rettig, W.H. *Trans. Am. Nucl. Soc.*; **22**: 264-265(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10719 **Sensitivity to peak cladding temperature to LOCA reflood parameters.** Oehlberg, R.N.; Scott, H.H. (Nuclear Regulatory Commission, Washington, DC). *Trans. Am. Nucl. Soc.*; **22**: 265-266(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10720 **Safety and security of nuclear power reactors to acts of sabotage.** Kouts, H.J.C. (Nuclear Regulatory Commission, Washington, DC). *Trans. Am. Nucl. Soc.*; **22**: 342(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10721 **Technique for determining high-trajectory turbine missile strike probability distributions.** Campe, K.M.; Read, J.B.J. (Nuclear Regulatory Commission, Washington, DC). *Trans. Am. Nucl. Soc.*; **22**: 361-363(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10722 **Information theory and nuclear risk.** Bari, R.A. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.*; **22**: 364-365(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10723 **Comparison of three disassembly models for a 1000-MW(e) fast breeder reactor.** Bleiweis, P. (Univ. of Illinois, Urbana); Ganapol, B.; Bowers, C.; Abramson, P.; Weber, D. *Trans. Am. Nucl. Soc.*; **22**: 371-372(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10724 **Effects of neutron streaming and geometric models on molten-fuel recriticality accidents.** McLaughlin, T.P. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.*; **22**: 372-373(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10725 **Consequences of fuel immobility in CRBRP overpower transients.** Ginsberg, T. (Brookhaven National Lab., Upton, NY); Erdman, C.A. *Trans. Am. Nucl. Soc.*; **22**: 376-377(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10726 **Combined deterministic/probabilistic fast reactor accident analysis procedure.** Fischer, G.J.; Bari, R.A.; Majumdar, D. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.*; **22**: 381-383(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10727 **Boiling flow regime maps in LMFBR HCDA analysis.** Fauske, H.K. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 385-386(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10728 **Boiling fuel-steel pool characteristics in LMFBR HCDA analysis.** Fauske, H.K. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 386(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10729 Melting of steel structure by flowing fuel or steel vapor. Cho, D.H.; Epstein, M. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 386-387(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10730 Melting attack of steel structure by a flow of molten fuel and/or steel. Epstein, M. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 387-389(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10731 Transient behavior of a volume-heated boiling pool. Epstein, M. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 389(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10732 Model for the molten-fuel flow through the fission gas plenum pin. Majumdar, D.; Hsu, C.J. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.*; **22**: 389-390(Nov 1975).
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10733 Nonequilibrium effects in vapor condensation on above-core steel blockage. Kazimi, M.S. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.*; **22**: 390-391(Nov 1975).
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10734 Recriticality studies in boiling pools of fuel and steel. Abramson, P.B. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 391-392(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10735 Burst energy requirements from normal operating power for LMFBR safety test facilities. Wright, R.W. (Nuclear Regulatory Commission, Washington, DC). *Trans. Am. Nucl. Soc.*; **22**: 393(Nov 1975).
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10736 Dispersal mechanism reactor test-feasibility study. Heineman, J.B.; Tzanos, C.; Matousek, J.F.; Fauske, H.K.; Marchaterre, J.F. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 393-394(Nov 1975).
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10737 Thermal transient analysis of a fuel pin based on the average properties and lumped parameter techniques. Chen, W.L.; Ishii, M.; Grolmes, M.A. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 396-398(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10738 Loss-of-flow calculations for the CRBR demonstration plant. Hummel, H.H.; Kalimullah; Pizzica, P.A. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 401(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10739 Some comments on CRBRP LOF analyses using SAS3A. Bohl, W.R.; Henninger, R.J. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 401-402(Nov 1975).
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10740 Further considerations on the LOF-driven TOP accident for LMFBRs. Alcouffe, R.E. (Los Alamos Scientific Lab., NM); Lois, L.; Meyer, J.F.; Speis, T.P.; Theofanous, T.G. *Trans. Am. Nucl. Soc.*; **22**: 402-403(Nov 1975).
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10741 Response of EBR-II and the plant protection system to off-normal primary flow. Dean, E.M.; Sackett, J.I. (Argonne National Lab., Idaho Falls, ID). *Trans. Am. Nucl. Soc.*; **22**: 403-405(Nov 1975).
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10742 Prediction of molten cladding motion in loss-of-flow accidents in LMFBRs. Ishii, M.; Chen, W.L.; Grolmes, M.A. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 406-407(Nov 1975).
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10743 Heat capacity effects in sodium boiling. Grolmes, M.A. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 407-408(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10744 Radiative cooling of a voided subassembly. Chan, S.H.; Condiff, D.W. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 408(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10745 Effect of boundary conditions on vapor explosions. Speis, T.P.; Denise, R.P. (Nuclear Regulatory Commission, Washington, DC). *Trans. Am. Nucl. Soc.*; **22**: 409(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10746 LMFBRs and vapor explosions. Fauske, H.K. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 411-412(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10747 Nucleation characteristics in physical explosions. Henry, R.E.; Fauske, H.K. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 412-413(Nov 1975).
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10748 Vapor explosions with subcooled Freon. Henry, R.E.; Fauske, H.K.; McUmber, L.M. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 413-414(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10749 Experiments on pressure-driven fuel compaction. Henry, R.E.; Erickson, E.G.; Heiberger, J.J.; Quinn, D.J.; Spleha, E.A.; Winsch, I.O.; Goldfuss, G.J.; Roth, R. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 414-415(Nov 1975).
From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

10750 Planning for nuclear emergencies. Moeller, D.W. (Harvard Univ., Boston); Selby, J.M. *Nucl. Saf.*; **17**: No. 1, 1-14(1976).

A properly developed and executed emergency plan represents an additional level of safety in dealing with potential accidents in nuclear facilities. A state-of-the-art review of the subject is presented which is based primarily on material presented by a variety of speakers during a short course held at the Harvard School of Public Health in May 1975. A certain degree of confusion has existed because of the multitude of federal and state agencies having responsibilities in this field; however, steps are being taken to correct this situation. Although updated Protective Action Guides for airborne releases have been published, similar action is needed for limitations on radionuclide intake via food and water. Indications are that, for a single puff type of airborne release, it may not be possible to evacuate the neighboring population within the short time span available to avoid exposure. For a longer term continuous type of airborne release, however, evacuation can be very useful. Still in need of further evaluation as an adjunct or alternative to evacuation is the use of protective shelter and/or radio-protective prophylaxis. Also in need of additional study

and/or development are methods for assessing the nature and course of an accident, techniques for rapidly estimating the pathway of a release and anticipated population doses, assessment of the long-range implications of potential widespread radioactive contamination of land areas, and improvements in the capabilities of state and local agencies in providing radiological emergency response. (auth)

10751 Partial blockages in LMFBR fuel assemblies. Fontana, M.H. (Oak Ridge National Lab., TN). *Nucl. Saf.;* 17: No. 1, 19-32(1976).

Experimental and analytical data on the effects of partial blockages in simulated liquid-metal-cooled fast breeder reactor rod bundles are reviewed and the results presented. Experiments performed in the Fuel Failure Mockup at Oak Ridge National Laboratory with 13- and 24-subchannel inlet blockages in 19-rod sodium-cooled electrically heated rod bundles indicate that excessive temperatures do not occur as a result of the blockages. Similar experiments with nonheat-generating blockages of 6 central subchannels and 14 edge subchannels in the heated zone of the rod bundle indicate acceptable local temperature increases at operating conditions. Experiments with water mockups show complex flow patterns in the wake zone behind blockages. Estimates of local convective heat transfer in the wake zone were made by measuring mass interchange between the recirculating flow zone and the free stream by salt-injection techniques. Generalizations obtained from the water mockups were used to predict temperatures in sodium-cooled rod bundles. Estimates indicate that large blockages (approximately 3 in. in diameter) would be required to cause sodium boiling in full-scale reactors. (auth)

10752 Anticipated transients without scram: status quo. Hagen, E.W. (Oak Ridge National Lab., TN). *Nucl. Saf.;* 17: No. 1, 43-54(1976).

The purpose of Report WASH-1270 is to ensure a high degree of reliability for the plant safety systems of water-cooled nuclear power plants to protect the health and safety of the public. Implementation of the requirements set forth in the cover letter sent with that report to the power utilities has been proposed by the utilities, and reviews of these responses and analyses are under consideration by the Nuclear Regulatory Commission. Acceptance of the utilities' positions has not been granted, nor has further guidance or direction been proposed for power plants now operating or under construction. Future plants apparently will have to incorporate some as yet undefined design for a dual-acting plant safety system. (auth)

10753 Selected safety-related occurrences reported in September and October 1975. Casto, W.R. (comp.). *Nucl. Saf.;* 17: No. 1, 106-111(1976).

Included are discussions of the following occurrences: the transients caused by the Oconee-3 control system, the release of noble gases at Zion, and a feedwater line break at Quad Cities-2. (DG)

ACCIDENT LIABILITY

REFER ALSO TO CITATION(S) 10589

ENERGY STORAGE

REFER ALSO TO CITATION(S) 10762

CHEMICAL

REFER ALSO TO CITATION(S) 10378

BATTERIES

DESIGN AND DEVELOPMENT

10754 Recent developments in advanced secondary batteries. Barger, H.J. Jr. (Army Mobility Equipment Research and Development Center, Fort Belvoir, VA). pp 24-28 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

The status of some advanced secondary batteries is reviewed. The impact of such systems on energy conservation and the environment is examined. 11 figures. (auth)

10755 Thermal battery. Baldwin, A.R.; Reinhardt, T.A. (to U.S. Energy Research and Development Administration). US Patent 3,914,133. 21 Oct 1975. Filed date 17 Apr 1973. 4p.

PAT-APPL-351,926.

An improved thermal battery which includes a depression at the interface of electrolyte pellet and anode for trapping of molten material between them is described. 5 figures. (auth)

PERFORMANCE AND TESTING

10756 (AD/A—005065) Wettability of the casing and electrolyte leakage in airtight nickel—cadmium storage batteries. Boldin, R.V.; Sushentsova, S.N.; Milyutin, N.N. Translated from *Sb. Rab. Khim. Istochnikam Toka;* 7: 161-163(1972). 7p. (FSTC-HT—23-1002-74). NTIS $3.25.

The results of studying the wettability of 08KP steel used for manufacture of storage battery casings, with an alkali solution at various potentials of the metal's surface are presented. It is shown that greatest wettability, and consequently, an increased tendency toward electrolyte leakage along the storage battery casing is observed when the casing is connected electrically to the negative block of electrodes; smallest wettability is observed when the casing is insulated from the working electrodes. (GRA)

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 10927

10757 (AD/A—005055) Development of an aircraft battery conditioner/analyzer. Final report, 19 June 1972—18 December 1973. (Chrysler Corp., New Orleans, La. (USA). Space Div.). Dec 1974. Contract DAAJ02-72-C-0108. 44p. NTIS $3.75.

The report documents the development and evaluation of a prototype Programmed Peak Charges (PPC) battery conditioner/analyzer system for nickel-cadmium batteries. It describes testing to determine the advantages of the unit as compared to constant-potential-charge systems. The results show that the PPC system reduces water boiloff, reduces overtemperature conditions, and has fewer battery recycles and cell replacements. Use of the PPC system increases battery life, reduces maintenance, and eliminates hazards. (GRA)

10758 (AD/A—005060) Effect of cobalt on the characteristics of lamellar structure nickel oxide electrodes operating in a zincate electrolyte. Kuzmin, Yu.A.; Mashevich, M.N.; Uflyand, N.Yu.; Frolova, S.P. Translated from *Sb. Rab. Khim. Istochnikam Toka;* 7: 163-167(1972). 9p. (FSTC-HT—23-0999-74). NTIS $3.25.

A lamellar structure nickel oxide with an additive of cobalt has stable and high efficiency for nickel (68--75 percent) in a zincate electrolyte. Replacing the nickel oxide with a metal ceramic lamellar structure electrode with cobalt additive results in a low-cost nickel-zinc storage battery; in specific characteristics it is close to cadmium-nickel and iron-nickel, with average discharge voltage exceeding the voltage of the latter by 0.4 V, that is, by 32 percent. (GRA)

10759 Interelectrode separator for electrochemical cell. Battles, J.E.; Mrazek, F.C. (to U.S. Energy Research and Development Administration). US Patent 3,915,742. 28 Oct 1975. Filed date 7 May 1974. 6p.

PAT-APPL-467,683.

A high-temperature electrochemical cell includes an anode containing an alkali metal, a cathode containing a chalcogen, and an electrically insulative separator wetted with electrolyte between the electrodes. The separator is a porous layer of boron nitride processed to be substantially free of B_2O_3. This purification prevents the formation of an electrically conductive layer resulting from reactions involving boron oxide. 2 figures. (auth)

APPLICATIONS

REFER ALSO TO CITATION(S) 10754

ENERGY MANAGEMENT AND CONSERVATION POLICY

REFER ALSO TO CITATION(S) 10818

RESEARCH AND DEVELOPMENT

REFER ALSO TO CITATION(S) 10888

10760 (AD-A—008887) **Technical review and analysis of national energy research and development programs and proposals (Phase II). Final report, 4 Apr-7 Oct 1974.** Singh, T.; Marks, A.H. (Nottingham (H.D.) and Associates, Inc., McLean, Va. (USA)). 7 Oct 1974. Contract DAAK02-74-C-0214. 280p. NTIS $8.75.

The scope of this investigation included a survey of the energy research and development programs being pursued in the United States. Included is a review and analysis of the recently completed projects as well as current and future energy R and D programs. Principal objectives were: to identify projects or programs having a potential application to the fixed facilities of the Army; to assess the state-of-art of the technology; and to determine the impact of such R and D programs on the Army's facilities. (GRA)

10761 (ERDA—76-13) **International Energy Agency with emphasis on the Subgroup on Energy Research and Development and the Energy Conservation Working Party.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Buildings and Industry). Dec 1975. 38p. Dep. NTIS $4.00.

As a result of the 1973 oil embargo and rising oil prices the United States and other members of the Organization for Economic Cooperation and Development (OECD) created an International Energy Agency (IEA) to administer an International Energy Program. The program's objectives are to insure that all participating countries will be able to satisfy their minimum oil requirements; to promote cooperation between oil-producing and oil-consuming countries; and to reduce dependence on imported oil through research and development, energy conservation, use of alternative energy sources, and uranium enrichment. Of the agency's four Standing Groups, the Standing Group on Long Term Cooperation on Energy is of particular interest to ERDA; it was formed to consider energy conservation, alternative sources of energy, energy research and development, and uranium enrichment. The Subgroup on Energy Research and Development has selected nine projects to explore the following: (1) hydrogen from water, (2) waste heat utilization, (3) municipal and industrial waste utilization, (4) coal technology, (5) radioactive waste management, (6) nuclear safety, (7) thermonuclear fusion, (8) solar energy, and (9) energy conservation. The U.S. is the lead country on (6) and (9). A Nuclear Safety Research Index is to be published annually. The Working Group on Energy Conservation is investigating thermalcharacteristics of buildings, heat pumps, thermal storage, and heat exchangers. Organizational data are presented. (MCW)

10762 (NP—20844) **Energy research and development program prepared by the Government of the Federal Republic of Germany. Annual report 1974.** (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany)). 1974. 286p. Dep. NTIS (US Sales Only) $9.25.

This is the first inventory presented by the energy research project management for research and development projects in the field of the non-nuclear Energy R and D Program 1974-1977, which are financially backed by the Federal Minister for Research and Technology and the Federal Minister of Economics. The report consists of a survey of the sponsored projects as of the end of 1974, supplemented by projects applied for, and being handled by, the project management. The survey has been classified in line with the subjects; the top level of classification is formed by the five priorities of the Energy R and D Program. The report also consists of the description of the individual projects already sponsored and includes coal conversion; mining technology and coal preparation; prospecting and disclosure of oil and gas; conversion, transport, and storage of energy; and efficient utilization of energy. The appendix is composed of a "Companies" register showing the program included in the report and the ministerial project of the institutions sponsored. A list of the BMFT expert committees acting as consultants in the field of non-nuclear energy research, together with the names of the experts, is given. (MCW)

10763 (PB—250592) **Improving heat pump performance via compressor capacity control: analysis and test. Volume I. Volume II. Appendices.** Hiller, C.C.; Glicksman, L.R. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jan 1976. 447p. (PB—250593; MIT-EL—76-001; MIT-EL—76-002). NTIS Vol. I, $7.75; Vol. II, $8.50.

The heat pump has long been of interest as a heating device because of its ability to deliver more heat energy than it consumes. The present work outlines past, present, and future developments in heat pump technology and indicates key areas of improvement. One method of improvement, the capacity controlled heat pump, has been studied in detail. An analysis of conventional and capacity controlled air-to-air heat pumps has been performed, using detailed computer simulations. New system sizing guidelines are outlined for capacity controlled units, resulting in as much as a 30% per year energy savings over conventional heat pumps in two of the six locations studied. Economic studies, comparing conventional and capacity controlled heat pumps to gas and electrical resistance heat, with and without air conditioning, indicate that capacity controlled heat pumps could soon be superior to gas heating in some locations, depending on energy prices. All of the economic studies have been done for a range of gas and electricity prices, and include amortization of capital costs as well as operating costs. Finally, preliminary development work on a new, potentially efficient and inexpensive, continuously variable compressor capacity control device is described. Test results on components of the early suction-valve cut-off control mechanism indicate that it is possible to design a controllable device to function in high speed (3600 RPM) compressors. However, more development work is needed. (78 references) (auth)

10764 **Analysis of the Federal energy research and development budget in a taxonomic framework.** Osner, G. (Washington Univ., St. Louis). pp 92-96 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

Federal energy policy priorities are mirrored in budget proposals for energy research and development (R and D). A taxonomic analysis reveals and defines those priorities. An application of the taxonomic framework proposed by Rose (Scientific American, Jan. 1974) is presented for the proposed federal R and D budget for fiscal year 1975. The analysis suggests that a disproportionate share is given to energy provision, as opposed to utilization and conservation, and that funding for technologies associated with the provision of electrical energy in particular is disproportionately large, amounting to about 76 percent of the total energy provision budget. (auth)

CONSERVATION

REFER ALSO TO CITATION(S) 10760, 10761, 10806, 10807, 10808, 10813, 10814, 10834, 10844, 10864, 10899, 10932, 10935, 10936, 10937, 10944, 10945

10765 (COM—75-10466) **Fuel conservation in ship operations. Technical report.** Zubaly, R. (Webb Inst. of Naval Architecture, Glen Cove, N.Y. (USA)). Jan 1975. Contract MA-2-4214. 46p. NTIS $3.75.

A study of ways to reduce fuel consumption by both short- and long-term changes in operational practices was made, using two typical North Atlantic container fleets as models. Fuel saving strategies are evaluated, all involving reductions in ship speed. (GRA)

10766 (CONF-751216—2) **Economic benefits of energy conservation.** Seidel, M.R. (Federal Power Commission, Washington, D.C. (USA). Office of Energy Systems). 1975. 29p. NTIS.

From Proceedings of energy conservation; Ft. Lauderdale, Florida, USA (1 Dec 1975).

'Energy Conservation' is taken to be the entire effort to shift the Nation's economy from pre-1973 trends of energy use to the pattern of uses which constitute 'Energy Thrift.' The magnitude of such cost-effective conservation can be estimated from marginal rates of substitution between energy and other factors of production, in response to the differential costs of energy in response to environmental and other increments of cost. It can be shown that post-1973 fuel price increases are consistent with the effects of environmental costs alone, and that conservation-oriented responses are more cost-effective than supply-expanding responses. This net cost-effectiveness constitutes the economic benefit of conservation. ... The benefits of conservation are realized in different ways by the various end-use sectors of the economy. The residential and commercial sectors can achieve numerous benefits by operational improvements, but efficiency-improving changes to the existing stock are much more important. Industry's benefits come through major changes in the nature of future processes. For transportation, mode shifts are the most important aspect for freight, but increased auto efficiency is most important for passenger transport. Utility conservation arises both directly, in improved generation efficiency, and indirectly through more efficient use of electricity. The benefits of conservation can also be characterized in terms of impacts on various aspects of the econo-

my. The most obvious of these is the capital requirement: while this is large, it is smaller than either the capital for supply expansion or the capitalization of increased fuel costs in lieu of conservation. ... The environmental benefits of conservation are significant. ... Conservation means increased labor intensiveness; this implies higher employment, but lower labor productivity. (auth, abstract modified)

10767 (FEA/D—75/335) **Energy management case histories. Conservation paper number 1B.** (Federal Energy Administration, Washington, D.C. (USA)). 1975. 27p. Industrial Monitoring Office, Federal Energy Administration, Washington, DC 20461.

National energy independence as a long-range goal for the United States will require reduction of domestic energy consumption through industrial energy conservation. The experience of many US firms has shown that the financial benefits of an energy conservation program can be substantial and a good management practice. This booklet discusses how Armstrong Rubber, Republic Steel, Collins and Aikman, and Swift companies each organized to achieve results, how they implemented their energy saving projects, and the results of their efforts. It is shown that improved cost control and competitiveness are available to all types of American industry. Improved stability of energy supply is also a benefit through the application of some of the practices. (MCW)

10768 (FEA/D—76/056) **Project Retro-Tech: teacher's kit for course on home winterization. Conservation paper No. 28.** Hill, R.; Kittridge, C.W.; Smith, N. (Federal Energy Administration, Washington, D.C. (USA). Office of Energy Conservation and Environment). Jun 1975. 157p. (FEA/D—75/613R; FEA/D—75/614R; FEA/D—75/459R; FEA/D—75/456R). NTIS.

The 'Teacher's Guide to Home Winterization' was prepared as a guide to teachers in developing lesson plans for a Home Winterization Course which promotes the utilization of known Retrofit Technology to improve thermal characterizatics and conserve energy in residential housing. The Kit contains: Teacher's Guide to Home Winterization; Home Winterization Job Book; Home Winterization Manual; and Home Winterization Charts. The 'Charts' are designed for the instructor's use in teaching the course. The 'Manual' and 'Job Book' are required materials for the student. The course is intended for either of two audiences: (1) for workcrew supervisors to train community services groups in utilizing retro-fit technology in residential housing, under government-aided winterizing programs, and (2) for vocational and avocational training of youths and adults enrolled in both accredited and non-accredited construction trade programs. (GRA)

10769 (FEA/D—76/078) **Energy conservation in new building design: an impact assessment of ASHRAE Standard 90-75. Conservation paper No. 43B.** (Federal Energy Administration, Washington, D.C. (USA). Office of Conservation and Environment). Mar 1976. 271p. GPO.

The objective of this study was to assess the energy, economic, and institutional impacts that may result from the broad voluntary adoption of American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Standard 90-75 by individual building regulatory authorities. This Standard is the first major voluntary consensus standard dealing with energy use in new buildings, and is available for optional acceptance by state and local governments. With strict use of the Standard, annual energy consumption would be reduced in all building types and locations. In applying ASHRAE 90-75, physical changes are brought about in exterior glass, exterior walls, insulation, lighting, and heating, ventilating, and air conditioning (HVA/C) system capacities. Considering the economic impact of the Standard, ASHRAE 90-75 modified buildings should cost no more to build than conventional buildings and would have substantially less annual energy costs. It is estimated that if this Standard were adopted throughout the U.S., the annual energy consumed in new construction would drop 27%; annual energy consumption in the Nation's buildings would also be reduced significantly. The examination of building materials and equipment markets concluded that the adoption of ASHRAE 90-75 would create opportunities for suppliers of commodity building materials at the expense of decreasing those markets for general building equipment and HVA/C systems. Impacts on key industry participants were also investigated. The most important effect of the Standard on the building habitability would result from reduced ventilation and infiltration. (56 references) (BYB)

10770 (NP—20678) **Recommendations for greater energy efficiency in large buildings.** (Tennessee Energy Office, Nashville (USA)). 1975. 7p. TIC.

A detailed list of energy saving suggestions, these recommendations concentrate on 'idea-joggers' to lower demand rather than a higher standards approach. Suggestions cover lighting, air conditioning, heating, air circulation, electrical equipment, water, insulation, and maintenance in large buildings. Emphasis is on turning things on only when they are needed and keeping buildings and equipment at peak performance. (14 references) (DCK)

10771 (NP—20680) **Checklist for energy conservation in the home.** (Tennessee Energy Office, Nashville (USA)). 1975. 7p. TIC.

A practical checklist of ways to conserve energy includes suggestions for home lighting, cooling, heating, insulating, use of appliances and tools, and placement of shrubs and trees. The guidelines incorporate good planning for energy conservative design and sensible use and maintenance of equipment. Suggestions range from frequent dusting of light fixtures to purchasing garments that require little or no ironing. Everyone in the home needs to be mindful of energy conservation. (DCK)

10772 (PB—240472) **Measures for reducing energy consumption for homeowners and renters. Staff report.** (Federal Power Commission, Washington, D.C. (USA). Office of Energy Systems). 25 Mar 1975. 24p. NTIS $3.25.

The report describes a comprehensive set of measures that can lead to a large reduction in the quantity of fuel consumed by the typical residence. It contains two tables and describes the measures under each segment of use. The report also points out that the savings given are not additive, since most energy conservation measures interact with one another. In addition, for the two most important areas of space heating and hot water heating, estimates of energy saved for the various options are given for different regions of the country. (GRA)

10773 **Defense energy conservation investment program.** Stipo, V.D. *Mil. Eng.*; **68**: No. 442, 111-112(1976).

As a complement to the over-all Department of Defense (DOD) conservation scheme, the Secretary of Defense in July 1974 approved a facilities energy conservation investment program. This program resulted from a Defense Energy Task Group recommendation that recognized the necessity of making a capital investment by retrofitting existing facilities for further conservation of energy. It is anticipated that, through this program, significant savings will be realized that will not only reduce energy consumption but also offset the spiraling costs of utilities. The projects that are eligible to be included in this program range from the simple storm window, sunshade, and insulation improvements to the more sophisticated energy recovery systems, power factor corrections, and utility load management systems. The criteria for FY 1976 limited the type of work accomplished to retrofit projects that could be amortized quickly and provide energy savings. No major new construction or repair work was included. In FY 1977, the payback period was increased to a maximum of 10 years and the inclusion of repair projects of $1 million or more that will provide high energy savings was permitted. This may appear to be rather high, but it is not when the condition of some existing utilities systems is considered. Major new construction was again excluded as it was determined that all new conservation construction should continue to be programmed and justified within the normal military construction program. (MCW)

10774 (PB—243923) **Industrial energy conservation: the CCMS pilot study. Project area 1. An international data base.** (Gordian Associates, Inc., New York (USA)). 25 Jun 1974. 74p. (FEA/D—74/142). NTIS $4.25.

Monitored by Dept. of Commerce, Office of Energy Programs under auspices of the NATO Committee on Challenges of Modern Society.

A draft is presented of the Committee on Challenges of Modern Society's analysis of Industrial Energy Conservation, and deals specifically with the area of an international data base. The Committee proposed a working group of representatives from all interested countries be established and that the United States would provide information on a data base already established for nine U.S. industries: aluminum, cement, copper, glass, paper, petroleum refining, plastic products, styrene butadiene rubber, and steel. It is anticipated that the project working group will make recommendations for potential follow-up phases, particularly with respect to techniques and operating practices that could be implemented within the next ten years. The Appendixes of this study present the background to the U.S. data base and the summarized data. The data consist of a compilation of energy consumption data process information in the nine basic industries, covering each step of the manufacturing process from raw materials extraction to maufacture of the end product. Energy consumption is presented by type of fuel used as well as total energy consumed. (GRA)

10775 (PB—244772) **Evaluation of the theoretical potential for energy conservation in seven basic industries.** Hall, E.H.; Hanna, W.T.; Reed, L.D.; Varga, J. Jr.; Williams, D.N.; Wilkes, K.E.; Johnson, B.E.; Mueller, W.J.; Bradbury, E.J.; Frederick, W.J.

(Battelle Columbus Labs., Ohio (USA)). 11 Jul 1975. 440p. NTIS $11.25.

This study is an effort to determine the minimum theoretical energy requirements in seven basic industries through a thermodynamic analysis of the processes employed in each industry. The study includes the steel, copper, aluminum, glass, synthetic rubber, selected plastics, and paper industries. Results of the calculations for these seven industries include the minimum theoretical energy, the efficiency of selected unit processes, and the effect of certain process changes on the energy use. A computer model was developed to perform the necessary calculations. The model performs the customary energy balances based on the first law of thermodynamics; availability losses are calculated according to the second law of thermodynamics. The results identify where large energy or availability losses occur. The information in the report will help direct the attention of process engineers to those operations which offer the greatest potential for overall fuel savings. (205 references) (GRA)

10776 (PB—245064) **Program to evaluate and demonstrate conservation of fossil fuel energy for single-family dwellings.** (Naval Weapons Center, China Lake, Calif. (USA)). Jun 1975. 75p. (FEA/D—75/529). NTIS $4.25.

A program is outlined, which will demonstrate reduction in U.S. fossil-fuel energy usage, particularly residential, shopping, and commuting. Goals include: combining more efficient energy use with low-energy structures to demonstrate that fuel consumption in single-family dwellings can be cut at least in half; reducing fuel consumption further; where solar flux is adequate, replacing use of fossil fuels in the single-family home with high temperature solar energy; and demonstrating a solar-powered, thermal-storage car for short trips. Areas included in this report as as follows: total energy system for single-family dwelling; retrofit house; low-energy structure (LES) using dynamic insulation; low energy houses (LEH); farther-term solution (storage-solar); control houses; cluster of houses; shopper-commuter vehicles; impact analysis-socio/economic; appliance energy/cost/rate structure; and life cycle energy analysis (LCEA). Each of these areas is considered in terms of background, goals, approach, critical areas, and details. The key to the program is a 'total energy system,' in which all energy needs are provided at the dwelling. (GRA)

10777 (PB—245149) **Analysis of a retrofit program for low-income consumers.** (Federal Energy Administration, Washington, D.C. (USA). Office of Consumer Affairs, Special Impact). Nov 1974. 112p. (FEA/E—75/273). NTIS $5.25.

An analysis is made of energy and the consumer price index, the problems of home heating, and home heating costs for the poor. A retrofit program is outlined for low-income families that tend to live in homes with fewer energy saving features than homes of the non-poor. The study is divided into three major sections: statement of the problem; a retrofit program which includes housing conditions of the poor, conservation and cost savings, crude oil savings, employment generation, and inflationary impact; scope of existing programs including existing funding sources and existing manpower and volunteer resources; and new programs including legislation relating to retrofit programs, a model bill, and a local delivery program. Appendixes include fuel price data for selected northern cities, current legislation relating to retrofit programs, cost analysis and identification of households, and identification of poor households by state, owner vs. renter occupied. (16 references) (GRA)

10778 (PB—245159) **Energy conservation potential in the cement industry. Conservation paper No. 26.** (Portland Cement Association, Skokie, Ill. (USA)). Jun 1975. 344p. (FEA/D—75/400). NTIS $9.50.

The potential for energy conservation in the cement industry is assessed. Chapter 1 covers projected energy requirements and examines the long-run growth patterns that will influence cement markets in Europe, Japan, and the U.S. Chapter 2 contains schematic process and flow diagrams and deals with the major steps required to produce a finished portland or modified portland cement from natural mineral deposits or industrial by-products. The discussion is divided into three steps: raw material preparation; pyroprocessing; and finish grinding and end uses. Chapter 3 deals with raw material preparation for manufacture of portland cement. Chapter 4 concentrates on pyroprocessing, production and energy consumption by process. Chapter 5 discusses finish grinding and treats divergent properties of raw materials with respect to grinding. Chapter 7 discusses alkali reactivity and by-product gypsum. Chapter 8 deals with energy-saving technology, that is, through use of preheaters, precalciners or major kiln modification or replacement. (207 references) (GRA)

10779 REMARKS PREPARED FOR DELIVERY BY THE HONORABLE ROGER W. SANT, ASSISTANT ADMINISTRATOR, FEDERAL ENERGY ADMINISTRATION, BEFORE THE ENVIRONMENT AND SAFETY BRIEFING SESSION, THE BUREAU OF NATIONAL AFFAIRS, STOUFFER'S NATIONAL CENTER INN, ARLINGTON, VIRGINIA, OCTOBER 30, 1975. Sant, R.W. Washington, DC; Federal Energy Administration (1975). 9p.

Published in the Federal Energy News, S-75-360.

Energy conservation is the ultimate goal of both programs to solve the energy crisis and clean up the environment, although some compromise and trade-off of goals are needed. There is a direct relationship between creating less pollution and improving the environment. By not making large capital investments and commitments to existing pollution control systems, immediate benefits can be obtained through conservation. For example, by using $80 million to insulate single family dwellings rather than installing coal stack scrubbers on new remote plants, less fuel would be required. Additional fuel needed to operate the scrubbers would be saved as well as less used by homeowners. Emissions from home furnaces would be less and coal stripping would be reduced. Consumers would pay lower utility bills. In the case of transportation, if the money required to meet emission standards for individual vehicles were used to buy company vans for commuters, there would be fewer miles driven, better air quality, commuter savings, and the beginning of a new transportation system. (DCK)

10780 Efficient energy utilization in industrial processes: an opportunity to improve our environment. Wald, D.E. (Maxon Corp., Muncie, IN). pp 49-54 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

General rules for conserving energy are presented. These stress the need for the most efficient energy delivery and utilization systems whenever possible. Information is included on the economic and environmental benefits of energy conservation, methods for measuring the efficiency of processes, methods for improving the energy efficiency of processes, and examples of good energy conservation practices now in use and usable in the future. (LCL)

10781 Energy conservation and pollution reduction in industry. Rossnagel, W.B. (Rossnagel and Associates, Cherry Hill, NJ). pp 55-56 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

The testing and installation of air pollution control equipment are discussed and several examples are cited of how both energy consumption and air pollution control have been achieved at industrial plants. Twenty-six guidelines for saving natural gas in high-demand areas are listed. (LCL)

10782 Transportation energy conservation policies. Hirst, E. (Oak Ridge National Lab., TN). *Science;* **192**: No. 4234, 15-20(2 Apr 1976).

The period 1950 to 1972 is examined with respect to personal travel and energy use for it, the relative energy efficiencies of different urban and intercity passenger systems are reviewed, several policies for reducing transportation fuel use are discussed, and the energy savings likely with each of these policies in 1980 and 1985 are compared. Four policies were selected for discussion here: (i) improving mass transit, (ii) increasing carpooling, (iii) raising gasoline prices, and (iv) imposing new car fuel economy standards. These were chosen because they are important and widely discussed, and because there are analyses with which to evaluate their effectiveness. However, there are several other options, such as stricter enforcement of a speed limit of 55 mph, wider adoption of right-turn-on-red, better urban traffic control systems, and a host of changes related to air traffic and freight traffic. It was concluded that, during the next decade at least, significant passenger transportation energy savings can be achieved only by improving new car fuel economy; such improvements can either be required by legislation or induced by increases in gasoline prices. Behavioral changes (greater use of mass transit and carpooling) are surprisingly insensitive to purely economic forces unless they are so strong as to be politically infeasible. The results suggest the need for more and better programs to encourage people to change their attitudes toward energy use and personal transportation. (auth, from Introduction)

SYSTEMS STUDIES AND TOTAL ENERGY

REFER ALSO TO CITATION(S) 10776, 10876, 10882, 10884, 10896, 10932

10783 (NP—20669) **Modeling large scale systems at National and regional levels. Report of a workshop held at Brookings Institution, Washington, D.C., February 10, 11, 12, 1975.** (Massachusetts Inst. of Tech., Cambridge (USA)). 1975. 50p. TIC.

The purpose of this workshop was to review existing regional and national models and to assess needed improvements for lengthening the time span of future models. Over 50 people heard reports on the experience and limitations of major models, which included econometric, input-output, environmental, energy, food, and other models. Diagrams and flow charts of several models are presented. Recommendations from the workshop were to: 1) broaden modeling efforts to include feedback; (2) establish a national center for modeling with data banks and basic model structures; (3) collect annual economic, social, and technical data; (4) develop a more standardized computer approach; (5) promote better understanding of modeling by decision makers; (6) develop two or more levels of complexity in models to provide both precise answers and popular use by laymen; (7) study benefits and costs of various goals; and (8) develop a validation system for models. (DCK)

10784 (NP—20670) **Situation report: energy networks.** (Kentucky Development Cabinet, Lexington (USA)). 1975. 92p. TIC.

A unified policy and strategy for developing coal and other energy sources is needed to predict the long-range impact of decisions and events on the Kentucky energy network. A description of Kentucky's network, this report serves as an inventory of the state's energy industry, provides descriptions of influencing factors and development trends, identifies opportunity areas, and outlines potential thrusts for the industry. The state uses 29% of the energy it produces and imports 40% of the energy it uses. Each of the major energy sources is discussed in terms of its production, use, distribution, storage, marketing, supply, and its network efficiency. External factors which influence manufacturing are equipment availability, communications, transportation, general economic development, and a combination of social factors and public policies. In 1974 the General Assembly appropriated $57.7 million to keep Kentucky competitive in the energy industry and to participate in U.S. energy independence programs. Potential thrusts recommended are a statewide energy program and policy to emphasize efficiency of coal-fired electric power generation, electric power transmission, comprehensive development in coal-mining regions, and development of renewable energy sources. (DCK)

10785 (PB—248997, pp 16-37) **Regional energy analysis: a state and National need.** Palmedo, P.F. (Brookhaven National Laboratory, Upton, NY). Nov 1975.

In Northeastern states confront the energy crisis.

The thesis of this paper is that many energy problems have a natural regional (rather than national or state) scale, and therefore, states within these 'natural regions' need to cooperate in planning energy policies. In addition to the geographical scale of energy planning, three time scales must be considered: short-term, in which fuel allocation planning and some regulatory functions take place; intermediate term, in which regional analysis should concentrate; and long term, in which major structural changes in the energy system can occur. The first step to regional energy planning would involve collecting regional data on energy supply and demand and developing energy models. Regional energy data and models would provide a necessary framework for planning, policy making, and energy regulating for the individual states, and would also enable regions of states to influence national policy in their interest. Available regional data and models are discussed, including the Brookhaven Reference Energy System model, which has been used for national energy planning studies as well as for regional analysis. (21 references) (BYB)

10786 (PB—248997, pp 38-59) **Regional economic and environmental impact of energy.** Polenske, K.R. (Massachusetts Institute of Technology, Cambridge, MA). Nov 1975.

In Northeastern states confront the energy crisis.

In order to solve energy problems, a comprehensive and systematic analysis of energy at a multiregional level is needed. This type of analysis would provide an understanding of the relationships between economic and environmental problems and the energy situation in all regions of the country. For most energy problems a regional reference for analysis is more applicable than a national framework; however, almost no regional analyses are available. Research funds are urgently needed for multiregional economic analyses of energy to be directed into the intermediate term (1 to 3 years) and the long term (3 to 5 years). In addition to a multiregional input-output model, these models would be useful to regional policy makers: models investigating the fuel-substitution and the model-substitution possibilities; and models that help evaluate power plant and refinery sites. The regional aspects of the use of coal by electric utilities (considering the generation of electricity, the ability of generating plants to use coal, transportation system capability, and Federal policies affecting coal) are discussed, particularly for the New England and Middle Atlantic regions. (12 references) (BYB)

10787 (PB—248997, pp 184-201) **Potential of regional energy modeling.** Garvey, G. (Princeton Univ., NJ). Nov 1975.

In Northeastern states confront the energy crisis.

In addition to considering political acceptability, commercial attractiveness, and technical feasibility, energy policy decisions should be developed with social processes in mind. Taking a regional framework for energy planning is the first step in dealing with social aspects of energy. The thrust of regional energy modeling should be on the administrative issues of energy problems rather than on political considerations. Increasing demand for energy in the Northeast will probably be a fact for the foreseeable future. Regional energy modeling should focus on methods to reconcile increased energy consumption with acceptable environmental standards. The regional approach to energy planning is seen as a supplement, not a threat, to established procedures for allocating resources through economic and political processes. (18 references) (BYB)

10788 ENERGY BASIS FOR MIAMI, FLORIDA, AND OTHER URBAN SYSTEMS. Zucchetto, J.J. Gainesville, FL; University of Florida (1975). 261p. Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, MI 48106 $20.00, Order No. 75-23,930.

A systems study of Miami, Florida is presented with data collected for the years 1950-72, cross-correlation analysis of the data, calculation of urban indices, computer simulation of mathematical models, construction of a land use map, calculation of major economic, fossil fuel, and natural energy flows, estimations of energy available from solar energy technology, and a theory relating economic competitiveness to the ratio of natural to fossil fuel energies. The urban system of Miami and Dade County, Florida, was used as a study area but the theory and approach could be used for any urban system. ... Cross-correlation analysis showed significant levels of correlation between the rate of change of fossil fuel use and the rates of change of population, budget, sales tax, income, building structure, and number of telephones. ... It was calculated that recycling of garbage could produce, at most, 2.7% of the fossil fuel energy consumption while solar energy technology used for hot water heating could save, at most, 3.5% of the total fossil fuel energy used in 1972. The energy flows associated with primitive, electrical, natural, gas, and solar water heaters are presented. The relationship of prices, money, and energy flows are discussed for urban regions in general and related to the future of Dade County in particular. As a final point of interest, an order-disorder formulation of the urbanization of South Vietnam was constructed which included main flows of money, growth of natural and urban systems, and destruction due to herbicides and general warfare. Results are presented for an herbicidal pulse lasting five years and different levels of U.S. aid. (85 references) (auth, abstract modified)

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 10799, 10820, 10851, 10852, 10856, 10860, 10871, 10878, 10897, 10902, 10904, 10908, 10912

10789 (AD-A—008938) **Projected regional energy availability in 1985. Final report, 1 Jul 1974-15 Jan 1975.** (Energy and Environmental Analysis, Inc., Arlington, Va. (USA)). 15 Jan 1975. Contract DAAK02-75-C-0080. 100p. NTIS $4.75.

Fixed Army facility energy requirements, in the context of national and regional energy trends through 1985, are evaluated. The national energy outlook in terms of the availability and price of various sources of energy is discussed. Demand and price forecasts are made for each energy source for each of nine census regions. Fixed Army facility energy demands are forecast within the nine regions by type of energy required. (GRA)

10790 (AD-A—008951) **Army installation energy requirements in continental U.S. Final report, 1 Jul 1974-15 Jan 1975.** (Office of the Chief of Engineers, Washington, D.C. (USA)). Jan 1975. 145p. NTIS $5.75.

This report displays data relevant to current energy consumption and gives estimates of projected 1990 energy require-

ments at 75 Army installations in the continental U.S. The current consumption of electrical energy is characterized by 10 energy regions and by type of installation. The totals for fuel consumption are presented by region, type of fuel, and size of boiler and heating plants. Future electrical energy requirements for troop installations were estimated, based on projected populations combined with current per capita consumption at each installation. Estimates for other installations were based on an estimated or assumed activity level. This study estimates a 7.2 percent increase in electrical energy requirements by 1990 and a 3.4 percent reduction in fuel requirements. (GRA)

10791 (CONF-751228—P1) **Creating energy choices for the future. Public meeting on a national plan for energy research, development, and demonstration held December 2, 1975 in Seattle, Washington.** (Energy Research and Development Administration, Washington, D.C. (USA)). 1975. 382p. Dep. NTIS $10.75.

From Proceedings on a national plan for energy research, development and demonstration; Seattle, Washington, United States of America *USA* (2 Dec 1975).

This public meeting was the second (the first was held at Altanta) designed to permit an exchange of information between the people of the Pacific Northwest and the Federal government, specifically the Energy Research and Development Administration, to provide information to the public and to receive input from the public about that agency's national energy research, development, and demonstration plan in creating energy sources for the future. The first speakers (Dr. Robert MacVicar, President, Oregon State Univ.; Mayor Wes C. Uhlman, City of Seattle; Dr. Robert Fri, Mr. Michael Yarymovych, and Mr. Roger LeGassie, ERDA Headquarters; Mr. Alex G. Fremling, Manager, ERDA Richlands Operations Office; and Mr. R. Glenn Bradley, Manager, ERDA Idaho Operations Office) discussed the plan and the energy situation for the Pacific Northwest, more or less setting the stage for later presentations. In addition to these seven speakers, presentations of 26 other speakers representing Federal and state governments, universities, and the private sector, as well as the panel discussions, are included in this volume. (MCW)

10792 (CONF-751228—P2) **Creating energy choices for the future. Public meeting on a national plan for energy research, development, and demonstration held December 2, 1975 in Seattle, Washington.** (Energy Research and Development Administration, Washington, D.C. (USA)). 1975. 227p. Dep. NTIS $8.00.

From Proceedings on a national plan for energy research, development and demonstration; Seattle, Washington, United States of America *USA* (2 Dec 1975).

This volume completes the exchange of information between the people of the Pacific Northwest and the Federal government, specifically the Energy Research and Development Administration. It includes 24 presentations primarily from the state, university, and private sectors, with panel discussions and questions from the floor after each four speakers. (MCW)

10793 (FEA-N—75/713) **National energy outlook.** (Federal Energy Administration, Washington, D.C. (USA)). Feb 1976. 593p. GPO $7.30, Stock No. 041-018-00097-6.

This report is an update of last year's 'Project Independence Report.' It concludes that the U.S. can achieve energy independence by 1985 without sacrificing its economic objectives. The study states that the U.S. oil imports, which are currently 6.1 million barrels per day (MMB/D), will continue to increase in the next two years, until Alaskan production begins. However, with gradual deregulation of oil and gas prices, intensive efforts to increase domestic production, and continuation of current world oil prices, 1985 imports could drop to 5.9 MMB/D, slightly below today's level. With accelerated production and increased conservation efforts, imports could decline to 1 to 2 MMB/D in 1985. If domestic oil and gas prices are regulated at low levels, however, imports could reach 13.5 MMB/D that year. The report points out that even if imports decline by 1985, they could increase again by 1990 as production from older oil fields declines. This decline will need to be offset by the use of nuclear power, coal, synthetic fuels, and emerging energy sources such as solar power. (GRA)

10794 (UCRL—5196(Rev.1)) **California energy outlook.** Behrin, E.; Cooper, R.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Feb 1976. Contract W-7405-eng-48. 49p. Dep. NTIS $4.00.

This report assesses the energy outlook for California in the years 1985 and 2000 based primarily on existing energy technologies. Projections are made for primary energy sources and energy demands in secondary and end-use markets in California. The general conclusion of the report is that fuel conservation, particularly in transportation, and increased supplies of oil and gas through the expected deregulation of oil and gas prices, as well as state imports of Alaskan oil, will sustain the California economy through 1985 without major increases in foreign imports. The resumption of offshore drilling in the Santa Barbara channel, exploitation of Elk Hills reserves, and the completion of the Alaska oil and gas pipelines are major factors in enhancing energy supplies in California through 1985. With current energy technologies, however, the California energy picture then deteriorates substantially in terms of oil and gas supplies, resulting in increased reliance on imported energy. For the period 1985 to 2000 new energy technologies must be developed to prevent a substantial deterioration in the standard of living due to rapidly escalating energy costs and/or increased reliance on uncertain foreign sources. (auth)

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 10278, 10766, 10786, 10787, 10788, 10815, 10822, 10824, 10824, 10831, 10847, 10850, 10859, 10862, 10870, 10873, 10881, 10891, 10893, 10894, 10895, 10898, 10900, 10901, 10905, 10909, 10944

10795 (CONF-7506125—, pp 147-155) **Multinational corporations and national economies.** Ogles, R.H. (Univ. of Colorado, Denver). 1975.

From Conference on societal implications of energy scarity(social and technological priorities in steady state and constricting systems; Portland, Oregon, United States of America *USA* (7 Jun 1975).

In Societal implications of energy scarcity: social and technological priorities in steady state and constricting systems.

Any structural analysis of change in a state or society which leaves out the notion of socio-economic class is considered deficient, even though the notion of social class may be difficult to define very precisely. This paper posits the existence of a ruling class or elite, which currently dominates the workings of western type capitalism. The net effect of this dominance is to exacerbate the differences along social class lines and to produce greater and greater inequities in the system. In response to scarcity, such ruling classes will operate for their own gain in such a way that the inequity will become greater, and repression will be a common tool for retaining a semblance of the existing power structure. It is argued that such occurrences tend to be a consequence of the capitalistic system as it has developed. The continued existence of development of repressive systems should lead to stronger attempts to redistribute resources, which in turn will lead to the development of groups and organizations actively working for changes within the system. (from editorial summary)

10796 (CONF-7506125—, pp 167-171) **Monitoring and assessing social impacts.** Carter, L.F. (Washington State Univ., Pullman). 1975.

From Conference on societal implications of energy scarity(social and technological priorities in steady state and constricting systems; Portland, Oregon, United States of America *USA* (7 Jun 1975).

In Societal implications of energy scarcity: social and technological priorities in steady state and constricting systems.

Methods being used to monitor and assess the social impacts of energy shortages and energy policy are described. Results of social policies are difficult to evaluate because observed changes may be due to uncontrolled changes in society rather than results of an experimental program. An adjustment in American life styles to deal with energy scarcity is considered probable. In order to make appropriate energy policy decisions, the social impact of these policies must be assessed and monitored. Data are being collected every two months through questionnaires to a random sample of Washington State residents. This information system is being developed to gather sufficient data of sufficient quality to enable policy makers to know what the public responses will be to a policy change. (BYB)

10797 (FEA—242-E) **Study of the effects of rising energy prices on the low and moderate income elderly.** (Federal Energy Administration, Washington, D.C. (USA)). Mar 1975. 150p. GPO $2.25.

Impacts of rising energy costs on low and moderate income elderly are assessed, including effects on income and expenditures, housing, and transportation. In the US the elderly poor consume less energy than any other age-income group, but they spend a higher proportion of their total budget on energy. Higher energy costs have adversely affected the cost and quality of care for the elderly in nursing homes. This study shows that natural gas, which is used predominantly for home heating, cooking, and water heating, is an essential energy source for the elderly. Concerning transportation expenditures, lower income households spend a smaller

portion of their budgets on transportation than other households. The elderly in New England and Middle Atlantic states were affected the most by energy price increases, while the south and southwest felt the impact of energy costs the least. Certain policies to alleviate impacts are recommended: (1) the establishment of a separate Consumer Price Index (CPI) for the elderly; (2) automatic CPI increases in Old Age, Survivors, and Disability Insurance (OASDI) and Supplemental Security Income (SSI) benefits; (3) an evaluation of potential impacts on the elderly of taxing energy sources to achieve energy conservation; (4) the development of mass transit facilities; (5) an adjustment of utilities' rate structures; and (6) greater assistance for improving housing conditions of the elderly.

10798 (PB—243627) **Defining and estimating opportunity costs for energy resources. Final technical report.** Mosback, E.J. (Faucett (Jack) Associates, Inc., Chevy Chase, Md. (USA)). 14 Jun 1974. 71p. (NSF/RA/N—74-210). NTIS $4.25.

The focus of this report and the proposed research is on applying two of the most fundamental principles of economics (logic) to energy. Market prices should reflect the minimum true social cost of energy consumption; decisions on production and consumption should be made by millions of decentralized decision makers guided by market prices, by their self-interest, and by their intimate knowledge of costs, values, and substitutions. No allocation scheme outside of market prices offers significant hope for utilizing the intimate knowledge and motivation of millions of decentralized decision makers and for attaining the self-correcting property of good market operations. Opportunity cost is the loss from foregone opportunities; in this study, the opportunity cost of a unit of energy consumed is the social cost of foregoing the opportunity to save it for 'later use.' The cost can be high if the best substitute in this 'later use' is very expensive and must be introduced soon; it is low if the best substitute is inexpensive or unnecessary for many years. (27 references) (GRA)

10799 (PB—244979) **General public attitudes and behavior toward energy saving: September report. Volume I.** Rappeport, M.; Labaw, P. (Opinion Research Corp., Princeton, N.J. (USA)). Sep 1974. 18p. NTIS $3.25.

This is the first monthly report of an on-going study of general public attitudes toward the costs and availability of energy. The study is based on 1,213 telephone interviews conducted over a four-week period ending September 6, 1974, with a national sample of adults in households having telephones. This report presents and discusses the results of the following questions: (1) seriousness and duration of the energy shortage (the public has come to believe that energy shortages are both a serious and a long-term problem); (2) causes and responsibilities (the degree to which people think the energy shortage is serious correlates very strongly with whom they hold responsible); (3) trust and performance (consumer groups are seen as the most trustworthy source of information); (4) knowledge; (5) solutions; (6) car pools; and (7) packaging. (GRA)

10800 (PB—244981) **Attitudes and behavior of residents in all-electric homes.** Rappeport, M.; Labaw, P. (Opinion Research Corp., Princeton, N.J. (USA)). Nov 1974. 14p. (FEA/D—74/503). NTIS $3.25.

This report is part of a series of studies dealing with general public behavior and attitudes. Specifically, this study concentrates on residents of all-electric homes. This report is based upon 100 personal interviews conducted among residents in two all-electric communities in West Chester, New York, and was compiled to determine in what way higher electric rates have affected behavior, and to learn whether residents are responding to higher rates through organized political action. The study takes into account the following: construction of the home; cost of heating; amount of yearly heating bill; total electric cost during the past 12 months; incidence of TV sets; and political action of residents outraged over increased electrical rates. (GRA)

10801 (PB—244982) **Energy consumption and attitudes of the poor and elderly: highlight report. Volume IV.** Rappeport, M.; Labaw, P. (Opinion Research Corp., Princeton, N.J. (USA)). Dec 1974. 16p. (FEA/D—74/504). NTIS $3.25.

This report is part of a series of studies dealing with general public behavior and attitudes towards energy conservation. Specifically, this study concentrates on energy consumption and attitudes of the poor and elderly, and includes respondents aged 50 or over, those having under $7,000 family income, and those who are 50 and over with incomes under $7,000. Survey questions included the following elements: seriousness of the energy shortage; length and severity of the energy shortage; real vs. contrived energy shortage; personal conservation efforts and their impact on total consumption of energy; attitudes toward specific government policies; changes in shopping habits as a result of inflation; cash payments vs. charging; means of transportation; and personal effects of the energy shortage. (GRA)

10802 (PB—244983) **Trends in energy consumption and attitudes toward the energy shortage: highlight report. Volume V.** Rappeport, M.; Labaw, P. (Opinion Research Corp., Princeton, N.J. (USA)). Dec 1974. 28p. (FEA/D—74/505). NTIS $3.75.

This report is part of a series of studies dealing with general public behavior and attitudes towards energy conservation. Specifically, this study concentrates on energy consumption and attitudes toward the energy shortage. The following issues are considered: seriousness of the energy shortage; duration of the energy shortage; perceived severity of the shortage; real vs. contrived shortages; effect of shortages on the public; satisfaction with President Ford's energy measures; effort made to save energy; suspension of emission controls; and effect of energy shortages and resulting price increases on people's behavior, including use of electricity, use of cars influenced by shortages, use of cars influenced by price, leisure activities, and hobbies at home. (GRA)

10803 (PB—244984) **Consumer attitudes toward gasoline prices, shortages, and their relationships to inflation: highlight report. Volume VI.** Rappeport, M.; Labaw, P. (Opinion Research Corp., Princeton, N.J. (USA)). Jan 1975. 30p. (FEA/D—75/506). NTIS $3.75.

This report is part of a series of studies dealing with general public behavior and attitudes towards energy conservation. Specifically, this study concentrates on consumer attitudes toward gasoline prices, shortages, and their relationships to inflation. Respondents to inquiries in the study were categorized according to whether their cars averaged under 15 miles per gallon, 15-19 miles per gallon, or 20 miles per gallon or more, and they were categorized by their average miles driven per week as follows: under 30 miles, 30-99 miles, 100 miles or more. The report includes data on the following: reasonableness of gasoline prices; efforts made to save energy; concern for gas mileage; attitudes towards rationing vs. higher prices; higher prices for low mileage cars; higher taxes on gas vs. taxes on cars; the environmental costs of producing more energy; environmental threats of energy self-sufficiency; power plants and pollution; water and air pollution; the impact of lowered car usage on rate of inflation; and sponsoring of ads on gasoline mileage. (GRA)

10804 (PB—244985) **Consumer attitudes and behavior resulting from issues surrounding the energy shortage: highlight report. Volume VII.** Rappeport, M.; Labaw, P. (Opinion Research Corp., Princeton, N.J. (USA)). Feb 1975. 44p. (FEA/D—75/507). NTIS $3.75.

This report is part of a series of studies dealing with general public behavior and attitudes towards energy conservation. Specifically, this study concentrates on consumer attitudes and behavior resulting from issues surrounding the energy shortage. The report is divided into four sections, as follows: highlights from Opinion Research Corporation's energy impact program; analysis of the role of education on attitudes and behavior; data on type of fuel used for home heating and its effects upon consumer behavior and attitudes; and a synthesis of available data dealing with the public's willingness to pay for pollution controls and environmental cleanup. The report also includes data on the rising cost of electricity; rationing; the role of education in attitudes toward strip mining; energy self-sufficiency; power plants and oil refineries as a cause of air pollution; and oil heat users. (GRA)

10805 (PB—244986) **Consumer behavior and attitudes toward energy-related issues: highlight report. Volume VIII.** Rappeport, M.; Labaw, P. (Opinion Research Corp., Princeton, N.J. (USA)). Mar 1975. 34p. (FEA/D—75/508). NTIS $3.75.

This report is part of a series of studies dealing with general public behavior and attitudes. Specifically, this study concerns important problems facing the country, such as unemployment, inflation, energy shortage, rationing vs. increased prices, increased oil import taxes, pollution control requirements, and nuclear power plants; sensitivity to rising gasoline prices; public awareness of FEA and specific FEA advertisements; certain energy-saving efforts among the general public and lack of public motivation and belief in the existence of an energy crisis; public attitudes toward nuclear power plants including thermal pollution, radioactive discharge, nuclear accident, or disposal of radioactive wastes. (GRA)

10806 (PB—244987) **Public's attitudes toward and knowledge of energy-related issues: highlight report. Volume XI.** Rappeport, M.; Labaw, P. (Opinion Research Corp., Princeton, N.J. (USA)). Jun 1975. 33p. (FEA/D—75/511). NTIS $3.75.

This report is part of a series of studies dealing with general public behavior and attitudes towards energy conservation. Specifically, this study concentrates on public attitudes toward knowledge

of energy-related issues, and includes attitudes toward nuclear power plants, the impact of school programs on home energy consumption, factors affecting the public's use of mass transit, and company efforts at energy conservation. Within these categories some of the following questions are considered: role of the school in emphasizing energy conservation; efforts of children to conserve at home; efforts of children to recycle; car pooling in relationship to long distance mass transit; availability of public transportation; interest in public transit for shopping; drawbacks to using public transportation; likelihood of using buses if special lanes were provided for them; impact of increased travel time; type of mass transit most needed; money for mass transit vs. highways. (GRA)

10807 (PB—244988) **General public attitudes and behavior regarding energy saving: highlight report. Volume X.** Rappeport, M.; Labaw, P. (Opinion Research Corp., Princeton, N.J. (USA)). May 1975. 29p. (FEA/D—75/510). NTIS $3.75.

This report is part of a series of reports dealing with general public attitudes and behavior. Specifically, this study concerns energy saving and is divided into six parts. The following topics are considered: responsibility for conservation of natural resources; public awareness of the Federal Energy Administration; attitudes and behavior related to daylight savings time; automobile usage and attitudes toward alternatives; and insulation of homes among the general public. (GRA)

10808 (PB—244989) **General public attitudes and behavior regarding energy saving: highlight report. Volume IX.** Rappeport, M.; Labaw, P. (Opinion Research Corp., Princeton, N.J. (USA)). Apr 1975. 50p. (FEA/D—75/509). NTIS $3.75.

This report is part of a series of studies dealing with general public behavior and attitudes. Specifically, this study concerns seriousness of the energy shortage, methods of solving the energy problem, inflation and increased prices, unemployment, and the rebate plan; the role of rebates to encourage installation of storm windows and insulation; attitudes toward gasoline use and gas taxes, including concern with automobile gas mileage; appliance purchases, including the price of appliances and the electricity they consume; and public attitudes toward returnable bottles and cans. (GRA)

10809 (PB—244990) **Energy-related attitudes and behavior of the poor and the elderly: highlight report. Volume XIII.** Rappeport, M.; Labaw, P. (Opinion Research Corp., Princeton, N.J. (USA)). Aug 1975. 26p. (FEA/D—75/513). NTIS $3.25.

This report is part of a series of studies dealing with general public behavior and attitudes towards energy conservation. Specifically, this study concentrates on energy-related attitudes and behavior of the poor and the elderly, and is divided into three parts: major problems in the U.S. and how they affect the poor and the elderly; plans for 1974 income tax rebates; and tradeoffs: pollution vs. price. Those people interviewed for the study include people whose family incomes are under $10,000, and people 50 years of age and older. Items included in the interviews are: problems facing the U.S. today, such as rising unemployment, inflation, energy shortage; looking ahead at the problem of unemployment; impact of inflation; the Federal government: spend or economize; trend in perceived impact of inflation; anticipated consumer price fluctuation; potential of income to keep pace with prices; fuels used in households; perceived and projected increases in prices of fuels; attitudes toward selling food to other nations; and ways to spend tax rebates. (GRA)

10810 (PB—245206) **Impact of rising residential energy prices on the low-income population: an analysis of the home-heating problem and policy alternatives.** (Department of Health, Education, and Welfare, Washington, D.C. (USA)). Dec 1974. 107p. (FEA/E—74/569). NTIS $5.25.

The effect of rapidly rising residential energy prices, specifically for home-heating fuels, on the lower income population is explored, and various policy alternatives to ameliorate this impact are analyzed. The study is also a response to a Congressional request to study the feasibility of a 'fuel stamp' program. The introductory section provides a summary of the findings of the paper. The second section analyzes the costs of home-heating and the particular needs of the low income population. In Section III, the responses to rising energy prices of programs such as Food Stamps, Aid to Families with Dependent Children, Emergency Assistance, Supplemental Security Income, and State and local assistance programs are reviewed. Section IV examines a number of policy alternatives designed either to provide additional purchasing power to low income households to meet necessary utility costs or to encourage the reduced consumption of home heating fuels through improvements in the thermal efficiency of living quarters. Section V examines certain proposed new programs, including a number of 'fuel stamp' proposals motivated by the rise in residential energy prices. (GRA)

10811 (PB—245828) **How the public views the Nation's dependence on oil imports, a possible natural gas shortage this winter, the overall need to save energy: highlight report. Volume XV.** Rappeport, M.; Labaw, P. (Opinion Research Corp., Princeton, N.J. (USA)). Oct 1975. 9p. (FEA/D—75/587). NTIS $3.50.

The general implication of this study is that the public seems not only ready to accept the fact that the era of cheap energy is over, but also recognizes the proposition that consumption of foreign oil needs to be reduced and domestic resources developed. The study views the public's opposition to increased dependence on foreign oil; the fear of a natural gas shortage this winter; and the concern over the need to save energy. Attitudes expressed in the study are especially significant in view of the recent meeting in Vienna of the Organization of Petroleum Exporting Countries (OPEC) and the efforts in Washington to reach a compromise on the decontrol of the price of oil and natural gas. (GRA)

10812 (PB—248997, pp 202-216) **Effects of energy shortages on the way we live.** Morris, D.H. (Rand Corp., Santa Monica, CA). Nov 1975.

In Northeastern states confront the energy crisis.

Major changes in patterns of energy use are expected to alter the life styles of people in highly industrialized societies like the U.S. To cope with more costly and scarcer energy supplies, consumers have three options: use energy more efficiently; reduce energy consumption; and switch to cheaper, more abundant energy sources. Trends in energy consumption are examined for the transportation and building sectors. Transportation uses 25% of all energy consumed, and more than 50% of all petroleum consumed. The number of cars has grown an average of 4% annually in recent years. At the same time, average fuel economy has decreased at a slow but constant rate. It is predicted that consumers will shift to smaller, more efficient cars; reduce non-essential driving; own fewer cars; and live closer to work and shopping areas. Considering energy consumption in buildings, space heating is the biggest end use. The homeowner can reduce the energy used for space conditioning by altering operating procedures; changing equipment; and modifying the building itself. Home energy use can be curbed by 27% by upgrading thermal efficiencies and resetting thermostats; these changes do not cause decreases in the standard of living or significant alterations in life style. Government policy alternatives are discussed, including advisory, incentive, and mandatory policies. It is concluded that consumers can reduce their total energy consumption by 20 to 30% without major hardships or changes in patterns of living. (BYB)

10813 **Specifications for recovered materials. Part I. A prerequisite to marketing.** *NCRR Bull.*; 5: No. 4, 86-96(Fal 1975).

An early step in planning for resource recovery, as discussed elsewhere in this issue, is marketing. But before marketing can be effectively carried out, consideration must be given to specifications for the products to be recovered; for specifications are the language between buyer and seller. Clearly, they also are important in determining the type of technology to be employed in a particular recovery facility. This is Part I of a two-part article reporting on an Environmental Protection Agency-sponsored project at the National Center for Resource Recovery to develop target specifications for materials, including a refuse-derived fuel product, recovered from municipal solid waste. Part I introduces the research and treats existing and proposed specifications for recovered paper and magnetic metals. Part II, to appear in the next issue of the NCRR Bulletin, will deal with aluminium, other non-ferrous metals, glass, and refuse-derived fuel. (MCW)

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 10764, 10784, 10785, 10787, 10791, 10792, 10794, 10796, 10802, 10803, 10804, 10805, 10810, 10811, 10840, 10854, 10861, 10864, 10865, 10866, 10870, 10877, 10879, 10888, 10891, 10892, 10893, 10894, 10895, 10899, 10902, 10907, 10912

10814 (AD-A—013554) **Management of Defense energy resources. Phase II report.** (Department of Defense, Washington, D.C. (USA)). 22 Jul 1974. 166p. NTIS $6.25.

An update of the Defense Energy Task Group's progress following the 1974 oil embargo and the formation of the Federal Energy Office, this report assesses current energy resources and outlines a plan for management. Estimated Department of Defense (DOD) demand on total U.S. energy (excluding nuclear) is 2.2%, with a 3.4% demand on total petroleum. Recommendations include: (1) continuing conservation efforts without sacrificing readiness; (2) retaining stand-by mandatory allocation procedures for petroleum and applying for coal allocation measures; and (3)

establishing and funding a five year Fuel Storage Improvement Program with an increase of petroleum inventory and a five year Facility Conservation Program. DOD will support efforts in exploration, development, and energy consciousness and management, and will participate in Project Independence. (DCK)

10815 (CONF-7506125—, pp 156-160) **Social scientist's role in energy policy.** Minor, M.J. (Univ. of Chicago). 1975.

From Conference on societal implications of energy scarity(social and technological priorities in steady state and constricting systems; Portland, Oregon, United States of America *USA* (7 Jun 1975).

In Societal implications of energy scarcity: social and technological priorities in steady state and constricting systems.

Data are summarized from the National Opinion Research Center's continuous national survey during the period from November 1973 through April 1974, which includes what is usually referred to as the 'energy crisis.' Among their interesting findings are: (1) persons generally tended to have negative feelings about gasoline rationing and that these feelings increased during this period; (2) 90% of those sampled seemed to see equity in the inconveniences experienced during that period, that is, they saw a fairly equitable distribution of hardship; and (3) that there was no real cutback in driving during that period of time. Data also indicate that most persons did not see the crisis as real: that is, there was no apparently widespread feeling of a crisis nature among those sampled. It is suggested that data such as these provide a baseline for future studies. In such studies social scientists should take a more active role and participate with policy makers in the necessary decisions. Such participation, however, also implies that social scientists must be willing to take responsibility for the decisions they are making, a position they often tend to avoid. The current processes of policy making seem to mitigate against such cooperation between policy makers and social scientists, but changes in this area may occur. (from editorial summary)

10816 (CONF-7506125—, pp 161-164) **Societal decision-making processes.** Clagett, F. (Washington Office of Community Development, Olympia). 1975.

From Conference on societal implications of energy scarity(social and technological priorities in steady state and constricting systems; Portland, Oregon, United States of America *USA* (7 Jun 1975).

In Societal implications of energy scarcity: social and technological priorities in steady state and constricting systems.

The process of governmental decision making is thought to be 'dysfunctional' in many respects. Criticism is voiced over the time it takes to accomplish even noncontroversial actions. Local, state, and National governments are disconnected, as illustrated by the budget system and budget cycles. The governmental system would operate much more efficiently if there were a relationship between local, state, and Federal fiscal and program planning. Historically, the development of new government commissions and agencies has contributed to the problem of disconnected government. In decision making, there has been a lack of consideration of side effects, secondary effects, and, particularly, of future impacts of current decisions. It is hoped that modeling techniques will improve policy decisions and future planning. Difficulties government has in managing water use for different purposes are described. Some positive steps in government policy are: the National Environmental Protection Act; Washington's State Environmental Act; and a 'A-95 process,' which provides for more effective use of Federal funds at the local level and coordination in local planning. (BYB)

10817 (CONF-7506125—, pp 165-166) **Northwest regional energy survey.** Adair, F. (Washington Department of Commerce and Economic Development, Olympia). 1975.

From Conference on societal implications of energy scarity(social and technological priorities in steady state and constricting systems; Portland, Oregon, United States of America *USA* (7 Jun 1975).

In Societal implications of energy scarcity: social and technological priorities in steady state and constricting systems.

The Northwest Regional Energy Study will try to determine the energy future of Washington, Idaho, and Oregon by studying the consequences of different energy options. Results of the Study will be recommendations on what policies and actions by institutions are needed to effect a desirable energy future. The potential societal, economic, and environmental effects of each energy scenario will be investigated. Widespread public participation will be an important element of the Study. (BYB)

10818 (NP—20666) **Iowa energy conferences.** Hocevar, C.J.; Lapp, R.; Kyl, J.H.; Sant, R.W.; Clark, W.; Freeman, S.D. (Iowa Energy Policy Council, Des Moines (USA)). 1975. 47p. TIC.

Texts of conference speakers and excerpted reports of ten regional conferences are included in this report. Carl J. Hocevar of Aerojet Nuclear Co. and the Union of Concerned Scientists opened by stressing public awareness of nuclear risks. Dr. Ralph Lapp of Nuclear Science Service countered by emphasizing the low probability factor of a nuclear accident. John H. Kyl of the Department of the Interior spoke of the importance of developing our resources, especially coal, and the need to make people understand the magnitude of the energy problem. A broad based program with good leadership was encouraged. Federal Energy Administration advisor Roger W. Sant discussed President Ford's energy program, which he considered tough but workable, given public awareness and education. Energy Policy Coordinator Wilson Clark called for developing new sources of energy and new ways to store energy. S. David Freeman, Counsel to the Senate Commerce Committee, spoke of the need for changes in public attitude and the importance of accepting individual responsibility. Regional reports covered: Sioux City, Cedar Falls-Waterloo, Dubuque, Fort Dodge, Council Bluffs, Mason City, Ottumwa-Fairfield, Cedar Rapids, Davenport, and Des Moines. (DCK)

10819 (NP—20667) **Energy: 1975. The first annual report of the Iowa Energy Policy Council.** (Iowa Energy Policy Council, Des Moines (USA)). 15 Jan 1975. 59p. TIC.

Iowans need to make decisions to select and develop a primary source of energy for electricity generation. Iowa's energy sources, with the exception of 2% from state coal and hydroelectric resources, are all imported. Future needs will require a mix of continued large imports, development of the 7.2 billion tons of coal reserves, and/or development of renewable energy resources. The political, environmental, economic, and social implications of four options (high consumption-low production, low consumption-low production, high consumption-high production, and low consumption-high production) are analyzed, and the following recommendations made: (1) all reasonable conservation efforts should be made; (2) individuals and corporations should seek out the opportunities that conservation offers; (3) conservation should include efforts to achieve energy efficiency, full cost pricing, and economic incentives; (4) end use control of natural gas should limit it to high priority uses; (5) oil imports should be limited and balanced inventories maintained; (6) construction of new electricity generation plants should be approached conservatively; (7) Iowa should increase its research and analysis of the nuclear power potential; (8) public funds should be provided for energy R and D; (9) energy policies should maintain high environmental standards; and (10) mandatory measures should be limited and energy policies should respect individual and corporate freedoms. (DCK)

10820 (NP—20668) **Energy: 1976. Second annual report of the Iowa Energy Policy Council.** (Iowa Energy Policy Council, Des Moines (USA)). 15 Jan 1976. 112p. TIC.

Projections of Iowa's energy needs, based on a 2% current growth, show that a ten-year increase in demand will have to be absorbed by imported coal and petroleum. No increase is projected for hydroelectricity and nuclear power, a negligible increase in renewable and recoverable sources, and a decline in natural gas and petroleum supplies to cover increases in demand. The Energy Council recommends: (1) sensible development of Iowa coal resources, with emphasis on liquefying and gasifying in situ and careful study of coal slurry pipelines; (2) elimination of the dual natural gas market by suspending federal control over new gas wells for 5 years; (3) balanced inventories of petroleum, gradual decontrol of petroleum prices, and substitution of domestic for imported petroleum; (4) rejection of a nuclear power moratorium; (5) state approval of all proposed energy park sites with caution in undertaking any new construction; and (6) rigorous efforts to conserve and recover energy. (DCK)

10821 (NP—20677) **Energy problem: a plan for Georgia's future.** (Georgia Center for Technology Forecasting and Assessment, Atlanta (USA)). 1 Jul 1974. 113p. TIC.

Georgia, which imports nearly all its raw energy, has developed a needs assessment and plan of action for meeting future energy requirements. Identified needs are based on a recognition of rising fuel prices and increasing energy demands. Although long range decisions must be made at the Federal and state level, most important short range decisions are made by individual consumers. State officials must provide leadership in conservation efforts and financial and administrative organization to develop future energy sources. The Georgia Energy Council recommends nine state policies, and lists specific appropriate actions, such as incentives, contingency plans, and research programs. Tables of conservation measures, ranked by ease of implementation, are presented with directions for implementation and expected benefits. Energy use policies developed in the state's interest should also be examined for their national implications. (DCK)

10822 (PB—240699) **Environmental regulations and energy for home heating.** Cohen, A.S.; Gardner, J.L.; Fishelson, G. (Chicago Univ., Ill. (USA). Center for Urban Studies). 1974. 12p. NTIS $3.25.

Prepared in cooperation with Argonne National Lab., Ill. Energy and Environmental Systems Div.

This report considers the effects of residential fuel policies on: (1) costs to tenants, landlords, coal distributors, and others affected by the regulation, (2) price of fuels, (3) human health and material property, and (4) air quality. The policies compared are: (a) no restrictions, (b) a low-sulfur law banning the use of fuels having more than 1 percent sulfur content, (c) a coal ban, still allowing oil with no more than 1 percent sulfur content, and (d) a complete ban on the use of coal and oil. Implications for national energy and environmental policies are discussed. (GRA)

10823 (PB—244741) **FEA Project Independence Report: an analytical review and evaluation.** (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). May 1975. 95p. (MIT-EL—75-017). NTIS $4.75.

The Project Independence Evaluation System (PIES), developed by the Federal Energy Administration to support their Project Independence studies, provides a first critical step in developing a coherent energy data base. PIES uses a set of models (engineering process, econometric, and mathematical programming) to integrate current and projected energy conditions with the impact of these conditions on alternative energy policies. Criticism of the Project Independence Report, while generally favorable, points up several weaknesses: (1) it underestimated the effect of price control on oil and gas supply and demand; (2) consideration of the financial health of investor-owned electric power utilities is omitted; and (3) it oversimplified the evolution of world oil prices to a stable level. As it stands, the Report is lacking analyses to help with policy decisions on price controls, import quotas, synthetic fuel development, and tariffs. (39 references) (DCK)

10824 (PB—246353) **Comparison of FEA figures with the Library of Congress Congressional Research Service's analysis of the President's energy program.** (Federal Energy Administration, Washington, D.C. (USA). Office of Quantitative Methods). 5 Feb 1975. 9p. (FEA/B—75/650). NTIS $3.50.

President Ford's energy program will not raise the Consumer Price Index as much as the Congressional Research Service first estimated. Consumers will pay an annual rate of $19.2 billion, rather than $50.3 billion. The new estimates are lower because of the following changes in assumptions: (1) oil imports will be reduced and demand for oil lowered; (2) with deregulation of prices, natural gas exploration will increase and more gas will be available for interstate contracts; (3) coal prices will not rise as high as anticipated because of long-term contracts and because gas and oil consumers cannot convert to coal; and (4) changes in utility accounting and pollution control equipment should not be included in the cost of an energy independence program. (DCK)

10825 (PB—247457) **State energy information systems: a survey.** DeForest, J.D. (National Governors' Conference, Washington, D.C. (USA)). Jul 1975. 63p. NTIS $4.50.

This 'state of the art' report outlines what is going on around the country in energy information systems. It contains a list of state energy contacts and recommends actions by state governments which could improve the quality of energy information. An overview is provided of the energy activities already underway in the states. This report is geared to decision makers anxious to develop a communications network within and among the states and minimize duplication of effort. (GRA)

10826 (PB—248997) **Northeastern states confront the energy crisis. Papers of the regional response to the energy crisis: a conference of legislative leaders from the northeastern states.** Rolison, J.P. Jr. (New York State Senate, Albany, N.Y. (USA)). Nov 1975. 316p. (NSF/RA/G—75-050). NTIS $9.75.

The purpose of this Conference was to allow state legislators to hear the best scientific and technical thinking available on energy. State legislators will ultimately have the greatest responsibilities for making policy decisions on energy; e.g., they formulate policies on home insulation, building codes, transportation, utility rate structures, refinery placement, nuclear plant siting, and taxes. Twelve papers, which are separately abstracted, were presented under these main sessions: 1) the State Challenge: Regional Energy Planning; 2) Sources of Energy: the Choices Ahead; 3) Insufficient Energy: the Trade-offs Involved; 4) State Legislative Use of Science and Technology; and 5) the State Legislative Response. (BYB)

10827 (PB—248997, pp 219-236) **Energy-echnenergy: the problem is putting information to work.** Rosenthal, A. (Rutgers—The State Univ., New Brunswick, NJ). Nov 1975.

In Northeastern states confront the energy crisis.

In addressing the question of how state legislatures should staff themselves in response to the energy crisis, this paper has tried to deal with the question of legislative staffing more generally. As far as state legislatures and legislative staffing are concerned, energy is not so very different from education or from other policy domains. Given the functions legislatures must perform, the structures upon which they rely, and the kinds of information they find useful, it seems that their chief requirement is for policy-information brokers. In most state legislatures the need is not for narrow, technical specialists; rather it is for staff that can mediate between technicians and legislators, translating the language and messages of expert professionals into that of generalist politicians. In energy as well as in education and other important policy domains, this need must be met if information is to be effectively put to work by state legislatures. The National Conference of State Legislatures (NCSL) State Legislative Fellowship Program is suggested as a method to meet this information need. This program proposes that the NCSL help train and equip new staff as information brokers in several state legislatures. (17 references) (from Concluding Comments)

10828 (PB—248997, pp 237-254) **Evaluation of mechanisms by which state legislators can obtain improved access to information on energy issues.** Feller, I. (Pennsylvania State Univ., University Park). Nov 1975.

In Northeastern states confront the energy crisis.

Various mechanisms by which state legislators can obtain improved access to scientific and technical information on energy-related issues are described and evaluated. Particular attention is given to the role of regionally based sources of information. The focus of this analysis is on the state legislature as a 'user' of information. For this reason, primary consideration is given to the type of information on energy issues that state legislators are most likely to require during the 1975 legislative sessions and to those factors which affect the utility to them of scientific and technical information. In addition, the assessment of the various mechanisms is based primarily on how well they fit within existing legislative structures, both within a state and nationally, rather than on the issues involved in obtaining improved cooperation from segments of the scientific and technological communities. (14 references) (from Introduction)

10829 (PB—248997, pp 258-279) **Energy regulation: a summary view of Federal limitations on state and local governments.** Jones, W.K. (Columbia Univ., New York). Nov 1975.

In Northeastern states confront the energy crisis.

There are two major Federal constraints on the power of state and local governments to impose regulations on energy supply and use. These governments may not enact or enforce regulations which violate the U.S. Constitution. The first constitutional constraint is the implied prohibition of the Commerce Clause, i.e., without Congressional approval, state and local governments may not establish regulatory controls which hamper intrastate or international commerce. Second, due to the Supremacy Clause of the Constitution, state and local governments may not enact or enforce regulations which are incompatible with a Federal regulatory program. This paper considers the limitations imposed by the following Federal legislation relating to energy supply and utilization: the National Environmental Policy Act; the Federal Water Pollution Control Act; The Clean Air Act; the Rivers and Harbors Act and related legislation; the Occupational Safety and Health Act; the Federal Metallic and Nonmetallic Mine Safety Act; the Atomic Energy Act; the Federal Power Act; the Natural Gas Act; the Natural Gas Pipeline Safety Act; the Transportation of Explosives Act; the Interstate Commerce Act and related legislation; the Ports and Waterways Safety Act and related legislation; the Federal Coal Mine Health and Safety Act; the Energy Supply and Environmental Coordination Act; the Emergency Petroleum Allocation Act; the Public Utility Holding Company Act; the Emergency Highway Energy Conservation Act; and the Noise Control Act. (175 references) (BYB)

10830 (PB—248997, pp 280-295) **State energy legislation and the siting of facilities.** Baram, M.S. (Massachusetts Institute of Technology, Cambridge, MA). Nov 1975.

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State response to energy problems must be systematic and rational, and should be directed towards the design of optimal approaches to ensuring adequate fuel supplies, necessary generating and transmitting facilities, coherent management of demand and supply, and the development of planning and implementation capabilities. As interdependencies are revealed in this process, state action should be linked to concurrent initiatives in other states and at the Federal level. A prime area for state action is the development of effective and environmentally sensitive programs for the siting of energy facilities. A wide variety of approaches to this sub-

ject are now being implemented or contemplated, and each state can benefit from an assessment of these alternative approaches of other states. Finally, a variety of approaches to siting reform developed and proposed by legal, planning, and other professional associations should be considered. The American Law Institutes Model Codes for land use reforms and the Report on Industrial Facility Siting by the Special Committee on Environmental Law of the American Bar Association provide extremely useful, objective analyses and findings. (A summary of the ABA report is included in the Appendix of this paper). The complexity and dynamic quality of energy problems provides a challenge to state legislatures which can be met through a systematic and staged approach. (from Conclusions)

10831 (PB—248997, pp 296-314) **Taxes and subsidies to affect energy consumption: efficiency and equity considerations.** Freeman, A.M. III. (Bowdoin College, Brunswick, ME). Nov 1975.

In Northeastern states confront the energy crisis.

The solution to the energy problem in both the short run and its long run variations requires some combination of a reduction in demand and an increase in supply. The major question is how much of each is required and how to strike the balance between decreasing demand and increasing supply. The 'price equals marginal cost' rule for economic efficiency is meant to provide some guidance in striking this balance. (Marginal cost is the cost of producing one additional unit of a good.) In this paper a number of possible uses of taxes and subsidies are discussed and evaluated, primarily in terms of their impact on the price-marginal cost relationship. The use of subsidies to mitigate adverse equity effects is discussed both in terms of their effectiveness, and in terms of whether they impede or assist the movement toward a price equals marginal cost efficiency point. (from Conclusions)

10832 IMPLEMENTATION OF THE CLEAN AIR ACT: 1975. HEARINGS BEFORE THE SUBCOMMITTEE ON ENVIRONMENTAL POLLUTION OF THE COMMITTEE ON PUBLIC WORKS, UNITED STATES SENATE, NINETY-FOURTH CONGRESS, FIRST SESSION. PARTS 1, 2, 3, AND 4. Washington, DC; Committee on Public Works (1975). 1911p.

An examination of the implementation of the Clean Air Act was undertaken in these hearings to determine whether any changes need to be made in the original Clean Air Act of 1970. Strategies for air pollution control were discussed to evaluate the soundness of the Act. Testimony was presented on the health basis of the Act, no-significant deterioration, costs vs. benefits, continuous emission limitation vs. tall stacks and intermittent controls, regulatory approach vs. economic approach to pollution control, and Federal preemption and National standards based on best available technology vs. health standards. Problems in meeting statutory requirements were considered for both stationary sources, transportation, and land use. Representatives of the Environmental Protection Agency testified on Title I, e.g., air quality standards, stationary source cleanup schedules, nondegradation, transportation controls, enforcement options, and air quality-related land use questions. Other witnesses included representatives of Federal, state, and city governments; industry; universities; private institutions and organizations; and utilities. A 130-page summary of the hearings, prepared by the Congressional Research Service, is included in the hearings. (BYB)

10833 SUMMARY OF ENERGY FACTS AND ISSUES. COMPILED BY THE STAFF OF THE COMMITTEE ON WAYS AND MEANS WITH THE ASSISTANCE OF THE CONGRESSIONAL RESEARCH SERVICE. Washington, DC; House Committee on Ways and Means (1975). 166p.

Included in this publication are: the President's proposed energy legislation, with analyses of the economic impact of these energy proposals; four briefs on specific energy issues; an address by Secretary of State Henry A. Kissinger on an international energy program; and approximately 20 statistical tables describing the energy situation. The President's energy program is designed to encourage development of fossil fuel resources; stimulate investments in development of new domestic energy resources; reduce energy consumption in buildings; accelerate siting and construction of nuclear and other energy facilities; establish a strategic petroleum reserve; and authorize various standby authorities to deal with possible energy emergencies. Differing opinions on the economic effects of the President's energy proposals are presented by the Administration, the Senate Committee on Internal and Insular Affairs, the Congressional Research Service, and the Federal Energy Administration. Energy issues are covered in the following briefs: 'Regulation of Natural Gas Producers'; 'Energy Conservation: Gasoline Tax Proposals'; 'Auto Fuel Economy Incentives'; and 'Legislation Options for Promoting Energy Conservation in Residential Buildings.' (BYB)

10834 BACKGROUND READINGS ON ENERGY POLICY. SELECTED MATERIALS COMPILED BY THE STAFF OF THE COMMITTEE ON WAYS AND MEANS WITH THE ASSISTANCE OF THE CONGRESSIONAL RESEARCH SERVICE. Washington, DC; House Committee on Ways and Means (1975). 892p.

This selection of recent articles and reports was compiled to present the House Committee on Ways and Means with information on energy issues as background for formulating a national energy program. Basic information is provided on the potential for expanding alternative energy sources and on energy conservation. The readings are organized under these categories: Energy Needs and Alternatives; Natural Gas: Supply and Policy; Tax Policy in the Energy Sector; Energy Conservation: Potentials, Policies, and Impact (including the industrial, agricultural, electrical generation, transportation, and residential/commercial buildings sectors; recycling of waste materials; alternative fuels; overall national programs; and gasoline); and International Implications. (BYB)

10835 PROPOSED REVISION OF MINING AND MINERAL LEASING LAWS FOR PUBLIC LANDS. HEARINGS BEFORE THE SUBCOMMITTEE ON MINES AND MINING OF THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS, HOUSE OF REPRESENTATIVES, NINETY-FOURTH CONGRESS, FIRST SESSION ON H.R. 8435. PART I. Washington, DC; Committee on Interior and Insular Affairs (1975). 144p.

Three witnesses discussed implications of new mineral leasing laws, agreeing that changes are needed to meet increasing demands for materials with minimum environmental damage. However, disagreement was voiced over the impact of new regulations on the small mining company and the amount of public lands withdrawn from mineral exploration. Small mining companies, which do preliminary exploration and have located most oil wells, will lose the ability to go to patent with competitive leasing. Big developers will be prevented from large-scale damage with heavy equipment. Because surface indications do not reliably identify mineral deposits, it is assumed that whatever proportion of land has been withdrawn will be the same proportion for potential mineral deposits. All agreed that with a lead time of 10 to 20 years from initial discovery to production, more flexible leasing, modernization of recording and securing claims, and exploration for domestic sources of currently imported minerals are vital. (DCK)

10836 Energy policy and utilization. Deutch, M.J. pp 70-80 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

The feasibility is examined of closing the gap between demand and production of domestic fuels by 1985 and of even exporting some energy by then. Topics included in the analysis are: (1) the meaning, the parameters, and the achievement of self-reliance; (2) US and world stability; (3) necessary actions and policy decision difficulties; (4) economic and environmental trade-offs; and (5) fluctuations in power demand. (PMA)

10837 Project Independence: executive summary. Stein, D.L. (Federal Energy Administration, Chicago). pp 81-87 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

A brief outline of the Project Independence Report, an evaluation of the United States energy problem, is presented. The scope of the report does not include a "blueprint" for reaching zero imports by 1980 nor specific policy recommendations, but rather, broad strategic options available to the US are considered. The strategies are evaluated in terms of alternative energy sources, dependence in imports, economic factors, environmental effects, and regional and social impacts. (PMA)

10838 COASTAL ZONE MANAGEMENT ACT AMENDMENTS OF 1975. REPORT TOGETHER WITH ADDITIONAL VIEWS ON H.R. 3981. Washington, DC; House of Representatives (1976). 135p.

Energy related developments since 1973 have resulted in increasing pressure on coastal states for (1) offshore exploration, (2) deep water terminals for supertankers, and (3) facilities to handle imported natural gas. The amended Bill provides authorization and financial assistance to the affected states for planning and controlling environmental and economic impacts. The Federal Energy Development Impact Assistance Fund will underwrite grants, loans, and loan guarantees to the states. The Bill is felt to provide a good balance of state and local rights with national needs to provide fu-

ture resources by appropriate development and conservation programs. Islands and the Outer Continental Shelf are included in the amended bill. Appropriations for 1975 were $12 million. (DCK)

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 10779, 10780, 10786, 10822, 10832, 10859, 10865, 10867, 10875, 10906, 10907, 10913, 10945, 11438, 11451, 11452

10839 (ERDA—110(Vol.3)) **Federal inventory of energy related biomedical and environmental research for FY 1974 and FY 1975.** (Energy Research and Development Administration, Washington, D.C. (USA)). Oct 1975. vp. Dep. NTIS $13.60.

Brief summaries are presented of energy related biomedical and environmental research studies sponsored by the Environmental Protection Agency during 1974 and 1975. (CH)

10840 (PB—241021) **Report to Congress on control of sulfur oxides.** (Environmental Protection Agency, Research Triangle Park, N.C. (USA). Office of Air Quality Planning and Standards). Feb 1975. 68p. (EPA—450/1-75-001). NTIS $4.25.

This report focuses on the compliance status of existing coal-fired steam electric power plants and on alternative methods for compliance with applicable emission regulations. Compliance alternatives include the use of low-sulfur coal, physical coal desulfurization, flue-gas desulfurization, coal gasification, fluidized-bed boilers, supplementary control systems, and energy recovery from solid waste. A review is presented showing the current status of existing coal-fired plants in terms of the sulfur content of coal purchased during the first half of 1974, the involvement of power companies in litigation challenging the applicable regulations, and the programs for achieving compliance with sulfur regulations in State Implementation Plans. (GRA)

10841 ENVIRONMENTAL REGULATIONS AND ENERGY FOR HOME HEATING. Cohen, A.S.; Fishelson, G.; Gardner, J.L. Argonne, IL; Argonne National Laboratory (1975). 10p. Argonne National Laboratory, Energy and Environmental Systems Division, 9700 S. Cass Ave., Argonne, IL 60439.

A cost/benefit study of environmental policies supports banning coal as an urban fuel. In an analysis of the Chicago area a coal ban resulted in costs exceeding benefits in only 16 of 172 square miles. In 54 areas benefits were double costs. Benefits include improved air quality, health, and savings on cleaning supplies, and showed no income or racial preferences. As coal use declines, natural gas and oil will increase in demand and price. Two methods for increasing natural gas price would be Federal deregulation of wellhead gas and a fuel policy allowing price increases in response to local shortages. (DCK)

10842 ENERGY AND THE ENVIRONMENT. PROCEEDINGS OF THE SECOND NATIONAL CONFERENCE HELD NOVEMBER 13—15, 1974, IN COLLEGE CORNER, OHIO. Earley, D.E.; Farber, P.S.; Buonicore, A.J.; Rolinski, E.J.; Theodore, L. (eds.). Dayton, OH; American Institute of Chemical Engineers (1975). 242p. (CONF-741179—).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

After an introductory paper, "Environmental Implications of Energy Use," by Anthony J. Buonicore, 41 additional papers were presented in the following sessions: Advanced Energy Sources, 5 papers; Energy Conservation and Storage, 6 papers; Energy Policy and Utilization, 6 papers; Fuel Conversion, 4 papers; Solid Waste Disposal and Resource Recovery - I, 5 papers; Solid Waste Disposal and Resource Recovery - II, 4 papers; Air Pollution Control Equipment for Particulates, 5 papers; Control of Sulfur and Nitrogen Oxides, 4 papers; and Thermal Pollution, 2 papers. A separate abstract is included for each of the 42 papers in ERDA Energy Research Abstracts (ERA) and for 10 of the papers in Energy Abstracts for Policy Analysis (EAPA). (LMT)

10843 Will shortages of raw materials and rising prices hurt our chances for better health care. Kline, A.B. Jr. (Public Health Service, Washington, DC). *Public Health Reports;* **90**: No. 1, 3-9(Jan 1975).

This paper was based on a speech presented at the 1974 American Health Congress held August 12-15, 1974 in Chicago, IL.

Due to shortages of energy supplies and other natural resources and rising prices, the health care sector should reevaluate current medical practices and plan for the uncertain future. A National Health Planning Council for Energy and Materials is proposed as an administrative group to design, develop, and disseminate information about modifications needed in health care procedures to cope with energy and materials shortages. Until such a council is established the following interim recommendations are made: 1) the Nation's health leaders should systematically monitor the relationship between geopolitical, geophysical, political, economic, and technological developments that affect medical services (e.g., hospital admistrators should form a closer liaison with their local utility companies); 2) construction should be designed to reduce energy consumption and material waste; 3) maintenance practices of health facilities should be improved and expanded; 4) studies should be conducted into the possibility of increasing cooperation with other hospitals in the same service area; and 5) health facilities should recycle their waste products. (20 references) (BYB)

10844 ENERGY STRATEGIES FOR HEALTH CARE INSTITUTIONS. Washington, DC; Public Health Service (1976). 44p. GPO.

Summary report of the four Energy Strategies' Conferences held June 8-10, 1975 in Atlanta, GA; June 29-July 1, 1975 in Boston, MA; July 20-22, 1975 in San Francisco, CA; and August 10-12, 1975 in Denver, CO.

Because health care is energy-intensive and energy-dependent, the availability and costs of energy are of major concern in planning and administering health services. This report summarizes the effects of the energy problem on health services and provides answers to current questions about energy conservation and fuel conversion. In 1975 the 7,200 hospitals in the U.S. consumed 15% of all energy used in commercial buildings, or the equivalent of 400,000 barrels of oil per day. Hospitals could potentially save 20 to 30% of the energy they now use. However, large amounts of energy are still necessary to maintain quality of care, and additional energy is demanded from manufacturers of medical supplies and pharmaceutical manufacturers. Although hospitals receive preferential treatment with regard to oil and natural gas allocations, energy supplies are not secure. Hospital administrators are urged to implement energy conservation programs immediately. This report describes general energy conservation program concepts and policies as well as practical aspects of energy conservation techniques, e.g., energy auditing, energy sharing or the modular integrated utility systems concept, energy monitoring, resetting of thermostats, and insulating. To deal with health care energy problems, a special action office within the Health Resources Administration has been established. (BYB)

ENERGY RESOURCES

REFER ALSO TO CITATION(S) 10784, 10798, 10819, 10835, 10869, 10880

10845 (Juel—1236(Pt.1)) **Chances for a long-term securing of the raw material supply to the FRG. Pt. 1.** (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany)). Sep 1975. 36p. (In German). INIS.

8 figs.; 11 refs.

The Federal Republic of Germany is almost completely dependent on raw material imports. Growing raw material consumption and an imminent increase in supply uncertainities will require intensified research and development work in the field of raw material safeguarding. Initial approaches to possible technical solutions are being indicated in connection with four raw materials (aluminum, copper, phosphate and carbon carriers). The material balances of these raw materials are shown and the technical and economic interrelations illustrated in the light of world-wide trends. It is being demonstrated that two essential objectives are to be pursued for securing raw material supplies: 1) extension of the raw material basis for primary and secondary raw materials, and 2) improvement of raw material utilization in all sectors of economy. To provide a solution for the wide spectrum of tasks, it will be necessary to establish adequate analytical methods and procedures. (DE)

10846 (PB—248997, pp 101-181) **Alternate sources of energy: their potential and feasibility.** White, D.C.; Meyer, J.W.; Jones, W.J.; Baker, R.H. (Massachusetts Institute of Technology, Cambridge, MA). Nov 1975.

In Northeastern states confront the energy crisis.

Working papers are presented on the potential contribution that alternate energy sources (i.e., synthetic fuels from solid fossil fuels, solid waste for electric power generation, energy from forests and plantations and other biomass, fuel cell power generation, hydrogen fuel, hydroelectric energy, geothermal energy, solar energy, ocean thermal energy, and wind energy) can make to U.S. energy requirements, particularly in the Northeast. The Northeast has little indigenous fossil fuel resources, but has a sound

technological capability, which can help solve its energy problems. It is concluded that in the near or intermediate future, these alternate energy sources must be considered supplementary sources, not substitutes for conventional fossil or nuclear fuels. Urban solid waste and increased energy productivity are thought to have significant near-term promise. (BYB)

FOSSIL FUELS

10847 (AD-A—009416) **Fuel feasibility study for Red River Army Depot boiler plant. Final report.** Ables, L.D. (Army Material Command, Texarkana, Tex. (USA). Intern Training Center). Apr 1975. 86p. (USAMC-ITC—02-08-75-201). NTIS $4.75.

This paper establishes economic breakeven points for the conversion to various fossil fuels as a function of time and pollution constraints for the main boiler plant at Red River Army Depot in Texarkana, Texas. In carrying out the objectives of this paper, the author develops what he considers to be the basic conversion costs and operating costs for each fossil fuel under investigation. These costs are analyzed by the use of the present worth comparison method, and the minimum cost difference between the present fuel and the proposed fuel which would justify the conversion to the proposed fuel is calculated. These calculated breakeven points allow a fast and easy method of determining the feasibility of a fuel by merely knowing the relative price difference between the fuels under consideration. (GRA)

10848 (NP—20796-P2) **Recommendations for a Synthetic Fuels Commercialization Program. Volume II. Cost/benefit analysis of alternate production levels.** (Synfuels Interagency Task Force, Washington, D.C. (USA)). Nov 1975. 359p. GPO $4.30.

Each alternative program was quantitatively evaluated allowing for such factors as: uncertainty, future influences, relative prices, technological change (learning curves), and other economic as well as non-economic values. In addition, the hedging or insurance value of alternatives was incorporated. Thus, the expected net benefit takes into account not only economic benefits but also the costs of embargo protection, environmental effects, and socio-economic effects. It is important to note that the mix of plants considered under each alternative program level is intended to be representative and was predetermined; no attempt was made to examine what would be the best (least cost) mix of plants from either the economic or environmental point of view. The expected costs of all commercialization alternatives considered exceed the benefits, and were greater for the larger programs. It is important to note that there is considerable uncertainty in net benefit incorporated into the cost/benefit analysis. The most crucial factors affecting the results are: the probability of a strong cartel; the cost of synthetic fuels; and the effect of the program on synthetic fuels costs. The Task Force sought to determine whether other energy initiatives (import restrictions by price or quota, energy storage), by either the executive or legislative branches of the Federal Government could affect the desirability of a synthetic fuels commercialization program. Finally, it was determined that the expected benefits of a program are relatively insensitive to reasonable changes in a number of other factors, some of which had undetermined positive benefits especially in some situations. For these reasons the smallest program (350,000 barrels/day oil equivalent) considered was recommended. (LTN)

10849 (NP—20796-P3) **Recommendations for a Synthetic Fuels Commercialization Program. Volume III. Technology and recommended incentives.** (Synfuels Interagency Task Force, Washington, D.C. (USA)). Nov 1975. 922p. GPO $12.75.

The technology and the incentives required and recommended to establish a commercially viable program directed toward achieving the President's goal of one (1) million barrels of crude oil equivalent per day in 1985 are presented. The available human, financial, and technological resources are identified and several optional production plans evaluated. The effects of other influences such as industrial capabilities, environmental protection standards, socio-economic values, and most importantly, the variability of world energy prices are considered. Justification for program direction and scope is provided, with special emphasis on developing equitable incentives, primarily financial plans in which the government helps in providing capital and/or financial protection to industry to design, construct, and operate production plants. The recommended incentives significantly reduce the amount of industry capital exposure and shift much of the cost for project failure and termination to the Government. The incentives may change the distribution of costs and, in so doing, reduce Federal taxes. Such foregone taxes are computed as a cost to the Government. The level of world oil prices will have a major effect on the cost to Government: rising prices could result in an inflow of money to the Government and largely offset initial subsidy payments. The incentives that were developed and evaluated, assumptions and criteria for selecting competing incentives, and the methodology employed in evaluating incentives are described. Analysis of each incentive considers its ability to meet the following criteria: effectiveness, competitiveness, administrative feasibility, federal involvement, flexibility, breadth of participation, existing authority, and contingency analyses. (LTN)

COAL

REFER ALSO TO CITATION(S) 10236, 10252, 10841

10850 (FEA/G—75/593) **Determination of labor/management requirements in the bituminous coal industry to meet the goals of Project Independence.** (Kramer Associates, Inc., Washington, D.C. (USA)). 27 Aug 1975. 76p. NTIS.

The objective of the report is to determine the manpower requirements for the bituminous coal industry on a production target for 1985 of 1,100 million tons as set forth in Project Independence. That target was derived from the assumption of 'Business As Usual,' namely, from the normal workings of the economic system in the absence of any special stimulus of government. An additional assumption in the projection of that target is that there will be during the next decade no significant changes in coal mining technology which would alter present methods of production. Research, experimentation, and demonstration may well succeed in developing new revolutionary methods of coal utilization for energy purposes, but the assumption is that these will not be sufficiently implemented by 1985 to have much effect on coal as an energy resource within that time period. (from Summary)

10851 (MIT-EL—75-021) **Supply of coal in the long run: the case of eastern deep coal.** Zimmerman, M.B. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Sep 1975. 87p. NTIS.

Examination of costs and reserves of coal to determine mineral reserves indicates that natural depletion, technological developments, and policy decisions must all be taken into account. Previous analyses using only a demonstrated reserve base of seam thickness do not give an accurate figure. Costs will be affected by shifts to deep mining and low sulfur coal mining for environmental reasons. Technological developments in mining engineering, processing, and stack cleaning will also affect costs. Other factors will be user response in terms of demand and substitution of other fuels, and rising labor costs. Rates of cost increases will be determined by the length of time given for adjustment. (13 references) (DCK)

10852 (NP—20671) **Kentucky's coal manpower: an assessment of needs and availability for increased coal production.** (Kentucky Development Cabinet, Lexington (USA)). Jun 1974. 86p. TIC.

An updated version of this report was abstracted in EAPA 2(4).

Estimates show that Kentucky has enough manpower to handle increased coal production, provided the state embarks on strong programs in public information, recruiting, training, and education. There are 12,632 unemployed men who are available immediately, and an additional 218,157 more men will become available by 1984. Although women were not included in the estimates, it is probable that they will be working in the mines. The state needs to take leadership in establishing a Coal Mining Manpower Development Program to train, monitor job opportunities, counsel, and recruit. In addition, the state should address itself to recoverable coal deposits, community and industrial development, information sharing, and transportation as they relate to mining. (40 references) (DCK)

10853 (NP—20676) **Kentucky's coal transportation: a special situation report; coal markets, distribution, and movement.** (Kentucky Development Cabinet, Lexington (USA)). Jun 1975. 108p. TIC.

An inadequate coal transportation system has kept Kentucky's coal production profits down. In order to meet increased demands on coal, some coal had to be bought at spot market prices to fill obligations from long-term contracts. Although railroads are second only to waterways as the most desirable way of hauling coal, shortages of railroad cars and reallocation of remaining cars to service new coal producers have caused an increase in trucking and serious damage to roads. The best transportation system would include the use of waterways and railroads for long hauls, conveyors and cable belts for short-range, high volume, and trucks for short-haul, small volume. An improved capital outlook and technical improvements in the transportation system are crucial. State and Federal agencies can be helpful by providing information and forecasts and by developing a regional approach to coal transportation. (DCK)

10854 (NP—20758) **Mineral resources of Alaska and the impact of Federal land policies on their availability. Coal: Alaska open file report 51.** McGee, D.L.; O'Connor, K.M. (Alaska State Dept. of Natural Resources, Anchorage (USA). Energy Resources Section). Mar 1975. 28p.

It is estimated that Alaska has 41,552 square miles of land on shore and 4,389 square miles of land underlying contiguous offshore areas along the western Arctic coast and in Cook Inlet that have the potential of containing economic deposits of coal; these areas are outlined on a map. Area by area, estimates of the demonstrated, inferred, and hypothetical coal resources in Alaska are indicated. Total recoverable coal resources, considered to be the coal listed under demonstrated and inferred coal resources, are 132.9 billion tons. In addition, hypothetical coal resources are 1.9 trillion tons. Total demonstrated, inferred, and hypothetical coal resources are 2.029 trillion tons. The present impact of the public lands withdrawn under section 17(d) of ANCSA is not as great on the availability of coal as it is on oil and gas. At this time, 82 percent of the total coal potential land is not leasable for coal development, and 83 percent of the total number of scattered coal occurrences (of unknown potential) are found on unleasable land. The greatest single impact is caused by Naval Petroleum Reserve Number 4, which includes approximately 44 percent of the total known coal potential land in Alaska. Approximately half of the total cost potential in the State may be closed to private development indefinitely. Ninteen percent may be opened in one to five years, and 17 percent may be open in five to ten years. If the present trend of Federal land administration continues in Alaska, its natural resource development will be chaotic. (from Conclusions)

10855 (PB—243393) **Chemicals from coal and shale: an R and D analysis for National Science Foundation.** Sherwin, M.B.; Frank, M.E. (Chem Systems, Inc., New York (USA)). Jul 1975. 436p. NTIS $11.75.

The economic and technical factors involved in the manufacture of primary organic chemicals such as olefins, aromatics, acetylene, ammonia, and methanol from coal and shale are analyzed. The technologies discussed are compared to present conventional technology which is based upon oil and natural gas. Chemical market demands and feedstock demands to the year 2000 are projected to estimate when coal and shale based processes would be required. The above inputs are utilized in outlining a research program which would insure the availability of this new technology. (GRA)

10856 (PB—245216) **Demand for coal for electricity generation: 1975-1984.** (ICF, Inc., Washington, D.C. (USA)). Aug 1975. 39p. (FEA/G—75/487). NTIS $3.75.

This study is a compilation of reports submitted by the Regional Electric Councils and relates to the status of their respective Bulk Power Supply Programs to the Federal Power Commission. These reports include projections of annual net generation requirements and scheduled generating capacity additions by primary fuel type through 1984 as well as detailed information on individual existing generating units including megawatt capacities and both primary and alternative fuel types. Analysis of the study is contained in 3 chapters: chapter one highlights significant trends observed in regional generation requirements and the composition of total generating capacity of fuel type; chapter two presents findings of a coal demand scenario that produces estimates of potential coal consumption levels for utilities, and analyzes the sensitivity of potential demand estimates to several key assumptions; and chapter three restructures the methodology employed in the previous chapter and presents estimates of probable utility coal demands for the 1975-1980 period, and compares these probable demand estimates with the potential demands from the previous chapter. (GRA)

10857 (PB—248997, pp 81-100) **Coal: energy of the past or future.** O'Leary, J.F. (Mitre Corp., McLean, VA). Nov 1975.

In Northeastern states confront the energy crisis.

Coal is the most abundant of U.S. fossil fuels, with estimated resources as of January 1, 1972 at 3,224,372,000,000 tons, or enough to meet total U.S. energy needs at 1974 rate for over 1,500 years. At present the U.S. consumes about 560 million tons of coal each year, with electric utilities becoming the dominant market for coal. Due to high construction costs for nuclear power plants, coal rather than nuclear fuels is predicted to be the fuel choice for most utilities for new additions to capacity. Means to transport coal include rail, truck, water, and pipeline; an increasing percentage of coal is also being used to produce and transmit electricity at the mine. Unlike other fuels in the U.S. coal demand is constrained by environmental regulations on air quality and surface mining, availability of capital, patterns of resource ownership, and material and manpower restraints. Policies needed to curb these constraints are discussed. This paper also describes several new technological innovations now being researched that are expected to improve production and use of coal. With proper governmental support, the coal industry will double in size in the next decade and triple by 1990. (BYB)

10858 DESIGN OF SURFACE MINING SYSTEMS. TASK ONE. RESEARCH AND DEMONSTRATION OF IMPROVED SURFACE MINING TECHNIQUES FOR THE EASTERN KENTUCKY COAL FIELDS. Princeton, NJ; Mathematica, Inc. (1974). vp. Kentucky Department for Natural Resources and Environmental Protection, Office of Planning and Research, Frankfort, KY 40601.

3 volumes.

The broad objectives of the study were (1) to identify modified mining technologies (equipments and methods) whose estimated economic and environmental characteristics were such that further research and field demonstration of the methods was warranted, and (2) to identify feasible and desirable modifications in the policies and procedures used in regulation of the industry by the Kentucky Division of Reclamation (KDR). Both qualitative and quantitative data were gathered and utilized. ... Six modified mining technologies (primarily methods) were subsequently designed. ... Estimates of the profitability of existing mining technologies were developed from mathematical models, and were validated using actual cost and revenue data for 38 randomly sampled mines. ... Desirable modifications to KDR management and operating procedures were identified and, in some cases, tested. A computer-based information system was developed and used to analyze data from all of the 4,136 surface mine inspections made in Eastern Kentucky during 1971. Procedures for improving the efficiency and effectiveness of mine inspection and surveillance were investigated. ... This report consists of three volumes. Volume I contains Chapter I, an introduction and summary of findings. Volume II contains Chapters II through VIII, in which the detailed findings appear. Finally, Volume III contains Appendices that show study methodologies and some of the data used in analysis. (auth, abstract modified)

10859 DYNAMIC ANALYSIS OF THE ENVIRONMENTAL AND SOCIAL IMPACTS OF COAL DEVELOPMENT IN THE EASTERN POWDER RIVER BASIN OF WYOMING: 1960 TO 2010. Jacobsen, J.J. Hanover, NH; Dartmouth College (1975). 231p. System Dynamics Group, Thayer School of Engineering, Dartmouth College, Hanover, NH 03755.

One of the dominant trends associated with the expansion in coal production has been the shift to the strip mining of coal in the western United States. This shift to western coal production has aroused controversy within western coal producing regions, and more generally, among factions favoring coal production in either eastern or western regions. In an effort to help understand and resolve these conflicts, a dynamic regional coal development model is constructed for the Eastern Powder River Basin of Wyoming. Using this model, the standard coal development scenario and a set of alternative development schedules drawn from a recent regional environmental impact statement submitted to the Department of the Interior are evaluated. To show the utility of formal computer models when used as communication and policy analysis aids in conjunction with environmental impact statements, whenever possible the data and structure for the model were drawn from the environmental impact statement. Policies involving exportation of 70 to 80% of an ultimate coal production of 180 million tons per year and the careful phasing of additional public services with population growth are found to be effective in reducing the social and environmental impacts of coal development. Alternatives involving large scale gasification or electrical generation development are found to have significant adverse social and environmental impacts on the region. (39 references) (auth, abstract modified)

PETROLEUM

REFER ALSO TO CITATION(S) 10803, 10837, 10838, 10874, 10912

10860 (FE—2216-1) **Impact of automotive fuel changes on the U.S. refining industry. An economic/technological assessment. Final report.** Frederick, F.P.; Moore, J.F.; Bonner, J.S.; Dickson, J.C.; Karvelas, L.P. (Bonner and Moore Associates, Inc., Houston, Tex. (USA)). 15 Nov 1975. Contract E(49-18)-2216. 47p. (ERDA—76-40). Dep. NTIS $7.60.

This study examines the economic and technological effects that would occur within the US refining industry if, by the year 2000, the US automotive fleet should require: more gasoline than currently projected, less gasoline than currently projected, or fuels other than gasoline - namely, diesel fuel or a "broadcut" fuel composed of crude fractions within a very broad boiling range.

The investigation was conducted by imposing various fuel demand forecasts (1975 through 2000) upon a mathematical model of the US refining industry. Study results indicate that: 1) existing refining technology will now allow the US refining industry to meet the demand imposed by introduction of an all-diesel auto fleet; 2) demands for "broadcut" fuel could be met, but the varying characteristics for this fuel would create fuel marketing and auto fuel system problems; and 3) all of the fuel demand patterns studied have measurable and important economic impacts on the refining industry; these impacts, however, are overshadowed by the effect which varying automotive fuel requirements have on the US demand for crude oil. Full study results and information on method are detailed in the study report. Additionally, a special study under slightly different fuel demand patterns is reported in Addendum 1 to the report. (auth)

10861 (FEA/G—76/158) **Early storage reserve plan.** (Federal Energy Administration, Washington, D.C. (USA). Office of Energy Resource Development). 22 Apr 1976. 104p. NTIS.

This Early Storage Reserve (ESR) Plan was prepared in response to Section 155 of the Energy Policy and Conservation Act (Public Law 94-163), which calls for storage of 150 million barrels of crude oil by December 1978. This ESR storage requirement will be added to the Strategic Petroleum Reserves (SPR) after the SPR plan goes into effect. ESR is to provide for fulfilling residual fuel and refined product needs in any region that is or is to become heavily dependent on imports. The feasibility of an ESR plan is demonstrated by discussing plans and work on: 1) how the ESR will be developed; 2) how it will be managed under normal and emergency conditions; and 3) what the environmental and economic effects of the ESR will probably be. (BYB)

10862 (NP—20665) **Absorptive capacity of the OPEC countries.** Newman, J.; McCowan, A. (Department of the Treasury, Washington, D.C. (USA)). 5 Sep 1975. 51p. TIC.

Reliance on market forces is the recommended way for the oil consuming countries to transfer resources to OPEC (Organization of Petroleum Exporting Countries). OPEC nations have so far reconciled their increased revenues and requirements with adjustments in prices and production, while allowing a deficit of services to grow. Aggregate imports are expected to increase from $37 billion in 1974 to $133 billion by 1985, but the annual increase in imports will decrease from 45% in 1974 to 8% by 1985. Redistribution of oil revenues will be handled differently by each country. OPEC investments abroad have increased, but consumer nations should avoid competing for investments with subsidies and guarantees. Individual analyses of the 12 OPEC countries show the distribution of surplus revenue to be heavily weighted toward Saudi Arabia, Iran, and Kuwait, while Libya and Nigeria are approaching equilibrium, and Algeria is using international loans to finance its imports. (DCK)

10863 (NP—20675) **Profile of the Maryland petroleum industry.** (Maryland Energy Policy Office, Baltimore (USA)). Sep 1974. 75p. TIC.

Oil enters Maryland by tanker and barge and by pipeline, with small amounts by truck. Since high standards limit the fuel that can be brought in, there are no refineries for finished products. Two major ports (Baltimore and Piney Point) and 235 miles of pipeline serve the state. Most of the propane used is transported by rail or truck tank cars. Distribution is made by primary suppliers (major oil companies with refineries), intermediate suppliers (oil companies without refineries), jobbers (branded or independent), distributors for kerosene and No. 2 oil, and retail gas stations. Petroleum products make up 62% of the state's energy. All but 5% of the gasoline sold is used for vehicles. Oil is used with coal for power plants and propane and oil for home heating. Rising petroleum prices are expected to increase demand for natural gas but not coal. Per capita income, population, and gasoline consumption have increased at a faster rate than the nation. Detailed demographic data profile county patterns of consumption and distribution. (13 references) (DCK)

10864 (PB—242493) **Utility oil savings study.** (Federal Energy Administration, Washington, D.C. (USA). Office of Energy Resource Development). Jan 1975. 41p. (FEA/G—75/255). NTIS $4.00.

In order to implement the President's October 8 initiative and to provide supporting analysis for the President's State of the Union energy proposals, Federal Energy Administration has coordinated the efforts of an interagency task force to examine alternative strategies for saving oil in the utility sector. This report includes an analysis of five measures to save oil and identifies the oil savings, associated costs, and constraints under alternative policy options. Particular emphasis has been accorded to measuring the impact on the oil savings objective of those initiatives proposed by the President in the State of the Union Message. The most significant legislative proposals which affect the outcome of this analysis are 1) amendments to the Clean Air Act, and 2) financial reform measures designed to alleviate utility cash flow problems which are inhibiting investment. (from Introduction)

10865 **OIL AND GAS DEVELOPMENT AND COASTAL ZONE MANAGEMENT. HEARINGS BEFORE THE NATIONAL OCEAN POLICY STUDY OF THE COMMITTEE ON COMMERCE, UNITED STATES SENATE, NINETY-THIRD CONGRESS, SECOND SESSION.** Washington, DC; Committee on Commerce (1974). 455p.

This first series of hearings on Outer Continental Shelf (OCS) oil and gas development (particularly along the Atlantic, Pacific, and Gulf of Alaska) and coastal management began the Committee's study to analyze National ocean policy and Federal ocean programs. Testimony was heard from representatives of the Council on Environmental Quality, who spoke on their recent study on the environmental impact of energy development on the OCS; university professors, who presented their research on the economic and environmental effects of OCS development and on OCS technology; environmental groups, who testified concerning environmental degradation resulting from mismanagement of OCS development; Senators and Congressmen; industrial leaders; and representatives of the American Petroleum Institute and the Western Oil and Gas Association, who stated that with safeguards, extraction of energy resources from oceans will not cause environmental problems. (BYB)

10866 **FEDERAL LEASING OF PETROLEUM ON THE OUTER CONTINENTAL SHELF. PREPARED BY THE CONGRESSIONAL RESEARCH SERVICE, LIBRARY OF CONGRESS, AT THE REQUEST OF HENRY M. JACKSON, CHAIRMAN, COMMITTEE ON INTERIOR AND INSULAR AFFAIRS, UNITED STATES SENATE.** Lindahl, D.M.; Useem, H. Washington, DC; Library of Congress (1976). 80p.

Background material is presented in support of the 1975 revision of the Outer Continental Shelf Act of 1953. Revisions were made in response to challenges of leasing procedures and national energy goals. Alternative leasing methods, including various combinations of bidding, profit, and risk allocation, are summarized. Basic purposes for the changes are to establish compromise measures that will generate Federal revenues and stimulate competition, protect the environment and develop oil resources, improve safety requirements and establish equitable liability procedures, and set coordinated guidelines while giving coastal states a larger role. (159 references) (DCK)

10867 **Literature review: movement of spilled oil at sea.** Fallah, M.H. (Regional and Environmental Studies, Mathematica, Inc., Philadelphia); Stark, R.M. *Mar. Technol. Soc. J.*; **10**: No. 1, 3-18(Jan 1976).

An overview of some of the important works on understanding the movement of spilled oil is presented. Works on four distinct modes of oil—water interaction are recognized: spreading, drift, diffusion, and dissipation. About 230 references are included, citing information on movement of oil slicks; oil pollution; detection of oil slicks; containment and cleanup of oil spills; and the degradation of oil spills. (MCW)

NATURAL GAS

REFER ALSO TO CITATION(S) 10781, 10834, 10838, 10865

10868 (IEA(M)—75-5) **Alaskan methanol concept: a pre-feasibility study.** Thomas, C.O. (Institute for Energy Analysis, Oak Ridge, Tenn. (USA)). 1975. 232p. Dep. NTIS $8.00.

Conversion of Alaskan natural gas to liquid methanol for shipment by pipeline or tanker appears to be feasible. Technical capability already exists, although major engineering difficulties will be caused by the Arctic climate. Methanol supply to the lower 48 states, increased by seven times, will be absorbed by expanding chemical and automotive industries and the electric utilities. At current prices, methanol with an estimated value of $2.60 per trillion Btu will be delivered at a price of $3.60, but the differential will not preclude economic feasibility. Recommendations are made for further study of production plants and transportation alternatives. (DCK)

10869 (PB—240638) **Impact of natural gas pipeline on mineral and energy development in Alaska. Open file report.** Bottge, R.G. (Bureau of Mines, Anchorage, Alaska (USA). Alaska Field Operation Center). 21 Mar 1975. 184p. (BM-OFR—20-75). NTIS $7.00.

The impact of one primary and seven alternative natural gas pipeline routes and their alternatives on Alaska's mining industry is discussed. Four routes begin on Alaska's North Slope and lead to the 48 contiguous States via Canada, while three routes lead to

tidewater where it would be liquified for transport to West Coast ports. This report summarizes the geology and the potential for mineral and energy development by 1:250,000 quadrangles through which the various pipeline routes pass. The potential impact along each route is then discussed giving the type of development likely and the number of people who could be attracted to the area. (GRA)

10870 (PB—246038) **Analysis of the economic impact of the deregulation of new natural gas wellhead prices.** (Federal Energy Administration, Washington, D.C. (USA). Office of Analysis, Office of Economic Impact). Jul 1975. 37p. (FEA/B—75/612). NTIS $4.00.

Deregulation of wellhead natural gas would allow prices to rise; however, long-term (15-20 year) interstate contracts will limit increases to the customer to about $13 to $18 a year by 1977. A combination of shortages caused by declining exploration and development and increases in industrial and utility demand for natural gas resulted from regulation. Analyses of two hypothetical studies, one on the relationship of deregulation to Project Independence and one on the effects of wellhead price rising to equal oil on a Btu basis, conclude that continued regulation will: (1) cause industrial cutbacks with decline in employment and production; (2) require more oil imports to replace gas; (3) lower air quality because of increased use of oil and coal; and (4) cause interstate pipeline service to decline. (DCK)

10871 (PB—246219) **Comparison of two natural gas forecasting models: TERA and MacAvoy-Pindyck.** (Federal Energy Administration, Washington, D.C. (USA). Office of Policy and Analysis). 10 Jun 1975. 43p. (FEA/B—75/639). NTIS $4.00.

The supply side of two forecasting models of the natural gas industry, the MacAvoy-Pindyck and the TERA, were each simulated under the same wellhead price scenarios, and the factors causing differences in the forecasts were identified. The two scenarios were Continued FPC Regulation and Phased Deregulation. The models produced very different forecasts of the level of potential production. The analysis showed the divergence between the forecasts to be attributed primarily to conservative success ratios in the TERA model which were initialized in 1973 at 3.6%, (only 67% of the 1968-72) and the high success ratios in the other model which were initialized in 1972-73 values but rise to 15-20% values by 1980. (GRA)

10872 (PB—246231) **Natural gas curtailments: 1975—76 heating season.** (Federal Energy Administration, Washington, D.C. (USA)). Oct 1975. 26p. Dep. NTIS $4.00.

On the basis of questionnaires sent to approximately 1700 businesses that deliver gas to end-use customers, an evaluation was made of the extent of natural gas curtailments for the period from Nov. 1, 1975, to March 31, 1976, for the 21 states considered to be the most critical. The economic impact was estimated, and the conditions and problems within each state were briefly summarized. The curtailment projections are tabulated. (JSR)

10873 (PB—249534) **Petroleum market shares: historical report on sales of propane to ultimate consumers, 1972 through 1974.** (Federal Energy Administration, Washington, D.C. (USA). Office of Policy and Analysis). Nov 1975. 113p. (FEA/B—75/703). NTIS $5.50.

Data provided by over 4,000 refiners and independent marketers of propane and propane-butane mixes, are summarized for the period January 1972 through December 1974. Companies surveyed accounted for over 90% of the propane produced and/or imported by the United States in 1974 as reported by the Bureau of Mines. Between 1972 and 1974, the market share of refiner sales of propane to ultimate consumers decreased 2%, nonbranded independent marketers' share increased 2%, and branded independent marketers' share remained constant. ... Nationally, the total sales of propane to ultimate consumers decreased 5% between 1972 and 1974. Sales to ultimate consumers in the Northeastern States increased 39 million gallons (5% above 1972 sales), and decreased 521 million gallons (6% below 1972 sales) throughout the rest of the country. The largest overall sales reduction of over 257 million gallons (8% below 1972 sales) occurred in the North Central States. Reduced propane supply in 1974 resulted from (1) reductions in the production of natural gas from which propane is produced, and (2) reductions in increasingly high priced imports. The market experienced increased demand for propane as a substitute fuel in applications affected by natural gas curtailments and decreased demand by petrochemical, residential, and commercial sectors. ... A summary of the performances of refiner marketers, nonbranded independent marketers, and branded independent marketers is presented in this report. (from Summary)

10874 **NATURAL GAS SUPPLIES. VOLUME II. HEARINGS BEFORE THE SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS OF THE COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE, HOUSE OF REPRESENTATIVES, NINETY-FOURTH CONGRESS, FIRST SESSION.** Washington, DC; Committee on Interstate and Foreign Commerce (1975). 223p.

Hearings were held in executive session on the amounts of natural gas available for delivery to interstate pipelines. Six witnesses from Getty Oil Co., Tenneco Oil Co., and Tennessee Gas Transmission Co. spoke under subpoena. Testimony and questioning were concerned with estimates of accelerated depletion times of oil fields. These new figures were based on a slower production rate caused by declining bottom hole pressure. Estimates of total amounts of recoverable gas have also declined. Older fields might be conserved by slowing gas removal. Internal recommendations for rate well studies to help time depletion of specific reservoirs have not been followed by oil companies. (DCK)

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 10278, 10855

10875 (PB—241942) **Environmental considerations for oil shale development.** Conkle, N.; Ellzey, V.; Murthy, K. (Battelle Columbus Labs., Ohio (USA)). Oct 1974. 132p. (EPA—650/2-74-099). NTIS.

Results of a preliminary literature study of the environmental considerations in the development of an environmentally acceptable oil shale industry are presented. The following seven different areas are included in the study: Oil Shale Deposits; Mining, Handling, and Pretreatment Processes; In-Situ Retorting; Ex-Situ Retorting; Retorted Shale Refuse Disposal; Other Environmental Considerations; and Product Treatment and Usage. Research and development needs required to eliminate inadequacies in the data base necessary to evaluate potential environmental problems are noted. The report provides an overview of the anticipated oil shale industry, including the magnitude of the resources available and the likely technical and environmental problems to be encountered. Specific technologies likely to be employed in the mining, oil extraction, and on-site upgrading processes are also identified. The status of development of these technologies and their potential economic, resource, and environmental impacts upon the oil shale resource regions and the nation as a whole are also described. (29 references) (auth)

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 10282, 10596, 10599, 10648, 10889, 10896

10876 (CONF-760303—3) **Low-temperature industrial process heat.** Spiewak, I.; Anderson, T.D. (Oak Ridge National Lab., Tenn. (USA)). 1976. 15p. Dep. NTIS $3.50.

From ASME-ANS joint international conference on advanced nuclear energy systems; Pittsburgh, Pennsylvania, United States of America "USA" (13 Mar 1976).

The market for industrial steam represents 17 percent of the total national use of energy. A study was carried out to evaluate alternate energy sources for this market, showing large nuclear reactors to be the lowest-cost steam source available. Small reactors were also investigated and appear to be a feasible option. There appear to be difficult institutional—organizational problems to be overcome to realize these potential energy sources. (auth)

10877 (NP—20664) **Nuclear energy: 1975. A report from the Iowa Energy Policy Council.** (Iowa Energy Policy Council, Des Moines (USA)). 2 May 1975. 59p. TIC.

A factual description of the growth in use of nuclear energy, types of plants, and licensing procedures, and a review of the nuclear fuel cycle grew out of public debate and pressure for a moratorium on nuclear power in Iowa. Information also includes transportation and safeguards data and summaries of the advantages and disadvantages of nuclear power. Energy Council recommendations cover: (1) exposure to ionizing radiation; (2) limits of exposure to medical radiation; (3) cost benefit analyses; (4) effects and probabilities of uncontrolled release of radioactivity; (5) limits of occupational and emergency exposure; (6) ecological programs; and (7) accounting for all existing and planned sources of radiation. A response plan is outlined for coordinated action in the event radioactive materials are released in the environment. Proposed state legislation requires a certificate of necessity to construct new electric generating facilities, strict public hearing, rehearing and appeal procedures, and application fees. (DCK)

10878 (PB—248997, pp 63-80) **Nuclear energy: the intermediate solution.** Lapp, R.E. Nov 1975.

In Northeastern states confront the energy crisis.

The time period until the year 2000 is termed 'intermediate, i.e., the time during which the transition of national energy sources from fossil fuels to non-fossil energy sources (primarily to nuclear energy sources) will occur. Due to limited domestic supplies and the high cost of oil imports, the U.S. can not continue to depend primarily on crude oil. Fossil fuels can not be converted to an acceptable oil substitute within the next one or two decades; therefore, the U.S. will probably increase its consumption of electric power from coal and nuclear fuels. A 2.3% annual increase in total energy growth is projected, with nuclear power increasing from a minor role in 1974 to a dominant position after 1993. The safety of nuclear power is asserted in discussions on routine radioactive releases, reactor accident risk, nuclear safeguards, and radioactive waste disposal. Graphs are included which depict: U.S. Energy Consumption, 1925 to 1973; U.S. Total Energy Consumption (1950 to 2000); Gross National Product and Gross Energy Consumption; U.S. Fossil Fuel Inputs--Electric Energy Generation (1950 to 1985); Energy Inputs to Electric Energy Sector (U.S.A., 1950 to 2020); Probability Distribution of Acute Fatalities for 100 Reactors; U.S. Energy Scenario (1974 to 2024); and Exploitation Requirements--Fossil Solids (U.S.A., 1960 to 2024). (BYB)

10879 (TID—26992) **Nuclear controversy.** Lundy, T.S. (Oak Ridge National Lab., Tenn. (USA)). 1976. 10p. Dep. NTIS $3.50.

An overview of the existing conflicts regarding the use of nuclear power plants to help solve the nation's energy problems is presented. Information from various sources on available energy options is combined with material gathered primarily at two conferences: (1) ANS Executive Conference: Nuclear Legislation Update; and (2) Critical Mass 75. The former was decidedly pronuclear, while the latter was specifically organized by antinuclear forces to develop strategy and stimulate action in the fight against the "nuclear menace." The nuclear moratorium vote scheduled for June 6, 1976 in the state of California and its possible effects are examined. A few comments are made on the recent resignations of the General Electric and NRC officials. The current situation in terms of the overall position of the Oak Ridge National Laboratory is discussed. (MCW)

10880 MINERAL RESOURCES AND THE ENVIRONMENT. SUPPLEMENTARY REPORT: RESERVES AND RESOURCES OF URANIUM IN THE UNITED STATES. Washington, DC; National Academy of Sciences (1975). 236p. Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue, NW, Washington, DC 20418 $9.25.

Significantly increased uranium production is possible for the short term, but after 1980 adequate production will be possible only if an increased exploration effort is begun now. Uncertainty in the mining and nuclear power industries is the greatest obstacle to expanded exploration. More effort needs to be made to increase knowledge of how uranium deposits are formed and to collaborate with government agencies to develop new detection techniques. Recommendations from the committee call for a firm national policy statement on the desired role of uranium-generated power with joint industry and government programs to share information and expedite exploration and development. Texts of 13 presentations provide background data on potential resources, collaboration techniques, and the problems as seen by both the mining and the nuclear power industries. (DCK)

10881 COMMENTS ON LMFBR COST - BENEFIT ANALYSIS. Alexander, A.J.; Rice, D.B. Santa Monica, CA; Rand Corporation (1975). 19p. (P—5498). Rand Corp., 1700 Main St., Santa Monica, CA 90406 $1.50.

Major changes in assumptions and development of a sequential procedure are indicated by an independent review of the Proposed Final Environmental Impact Statement (PFEIS) for the liquid metal fast breeder reactor (LMFBR). Comparisons of capital cost differentials show that, with LMFBR costs well above $100/kW more than light water reactor costs, LMFBR technology is not competitive with either LWR or fossil fuel generators. R and D costs may exceed the estimated $5 billion of the PFEIS if historical cost increases continue. Independent estimates which include price effects show that the growth of electrical energy demand has been overestimated and would make the LMFBR uneconomic. Contrary to PFEIS assumptions, uncertainties in costs, reliability, safety, technological capability, and licensing could create simultaneous adverse situations and further lengthen the time between front end costs and any net benefits of the program. A slowed down, sequential program of testing, evaluation, and public review will develop the trust and confidence needed to offset these problems. (DCK)

10882 NEEDS: Nuclear Energy Electrical Demand Simulation. Willke, T.L. (Battelle Columbus Labs., OH). *Simulation;* **26**: No. 2, 33-42(Feb 1976).

A computer model is presented called NEEDS—an acronym for Nuclear Energy Electrical Demand Simulation—which can simulate the nuclear sector of the United States electric power economy. The code can forecast the impact of various nuclear reactor growth patterns over the next fifty years in terms of economics, resource utilization, and the requirements for a supporting fuel-cycle industry. NEEDS was developed for the Office of Energy Research and Development Policy of the National Science Foundation as a tool to help evaluate alternative fission reactor development strategies involving advanced reactor concepts, including advanced high-temperature gas-cooled reactor (HTGR) systems, the gas-cooled fast reactor (GCFR), the molten-salt breeder reactor (MSBR), the light-water breeder reactor (LWBR), and the heavy-water reactor (HWR). The objectives of the study were to calculate the impacts, benefits, and requirements of various nuclear growth patterns and to determine the sensitivity of these measures to input parameters which are dominating, uncertain, or subject to wide variations. (auth)

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 10374, 10377, 10378, 10848, 10849

UNCONVENTIONAL SOURCES AND POWER GENERATION

10883 Alternative energy sources for the UK. Dawson, J.K. (Atomic Energy Research Establishment, Harwell, Eng.). *Atom (London);* No. 231, 11-20(Jan 1976).

The Energy Technology Support Unit augments the technical and scientific resources available to the Chief Scientist of the Department of Energy to assist in chosing the energy R and D strategy for the UK. This paper examines the contribution of alternative, renewable energy sources for the UK 25 years or more from now. Over the past 25 years the UK energy demand has been rising steadily at an average about 1.8 percent per year, supply being contributed by petroleum, coal, natural gas, nuclear, and hydro - with a total coal equivalent of 331 million tons. Projections for the next 25 years vary from 550 to 650 mtce. Details of conversion of solar, geothermal, wind, tidal, and wave energies are discussed. They are grouped according to whether they would be used primarily to produce heat or electricity. The production of secondary fuels such as ethanol or methane from solar energy is an additional option mentioned, but is not discussed in detail here. A scenario is presented showing the contribution that each of these sources might be able to make in the year 2000, providing a vigorous development and exploitation program results in approximate economic parity with other energy sources. Results indicate the total contribution will be about 6 to 8 percent of the overall energy demand 25 years hence. Solar and wave energy contributions could have the potential to grow to higher contributions if the biological routes to the recovery and storage of solar energy are included. (MCW)

SOLAR

REFER ALSO TO CITATION(S) 10415

10884 (N—75-28518) **Feasibility study of solar energy utilization in modular integrated utility systems.** (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). 30 Jun 1975. 181p. NTIS $7.00.

A study was performed to evaluate the feasibility and benefits of solar thermal energy systems on integrated utility systems. The effort included the identification of potential system concepts, evaluation of hardware status and performance of weighted system evaluations to select promising system concepts deserving of further study. (auth)

10885 (NBS-TN—892) **Retrofitting a residence for solar heating and cooling: the design and construction of the system.** Hill, J.E.; Richtmyer, T.E. (National Bureau of Standards, Washington, D.C. (USA)). Nov 1975. 99p. GPO $1.70, SD Cat. No. C13.46:892.

During 1972 and 1973, the National Bureau of Standards (NBS) conducted controlled laboratory tests on a factory-built four-bedroom house having a floor area of 110 square meters (1200 square feet) equipped with a conventional gas furnace and central electric air conditioner incorporated into a forced air dis-

tribution system. During 1974, the house was moved onto the NBS grounds and a solar heating and cooling system was designed to be added to the house. Calculations have been made to show that more than 75% of the yearly energy needs for heating, cooling, and supplying domestic hot water could be obtained from the sun. This report deals with the design and construction of the retrofitted system. It consists of 45 square meters (485 square feet) of double-glazed, flat-plate solar collector, 5.7 cubic meters (1500 gallons) of water storage, and a 10,000 W (3 ton) lithium bromide absorption air cooling unit. (59 references) (auth)

10886 SOLAR ORIENTED ARCHITECTURE. Tempe, AZ; Arizona State University (1975). 142p. Arizona State University, College of Architecture, Tempe, AZ 85281 $10.00.

Approximately 70 buildings in the U.S. and other countries, which are heated and/or cooled by solar energy, are analyzed architecturally to study the design modifications needed to incorporate the solar systems in the dwellings. One-page data sheets are provided for each solar building with information on: location, latitude, elevation, average temperatures, and horizontal insolation for January and July; facts about each structure and its subsystems for collecting, storing, and distributing heat in the winter and for air conditioning in the summer; and a perspective drawing of each building. The basic principles of solar space heating are analyzed, and the way these principles affect the design of buildings is described. Detailed descriptions and drawings are presented for ten selected solar residences; each of these buildings illustrates one of the four major methods of solar energy utilization. (60 references) (BYB)

10887 Solar expriment begins at Atlanta school. *ASHRAE (Am. Soc. Heat. Refrig. Air-Cond. Eng.) J.*; 18: No. 3, 53-56(Mar 1976).

The largest solar heating and cooling system undertaken to date is now operating at the George A. Towns Elementary School in Atlanta, Georgia. It is expected to provide more than 60 percent of the building's heating and cooling requirements, using commercially available components and techniques. The Towns project is a United States Energy Research and Development Administration-sponsored experiment. The principal components of the solar heating and cooling system designed for the school—the solar collector array, the existing gas-fired boiler, the absorption chiller, and hot and cold water underground tanks to provide thermal storage—are described. To derive maximum benefit from the experiment, the system is fully instrumented for accurate measurement of performance. Environmental data, including insolation and ambient temperture, humidity, and wind conditions will be recorded. The inlet temperatures, outlet temperatures, and the mass flow rates to the collectors, storage system, and absorption air conditioner will be sensed, and the supplemental energy provided by the gas boiler will be measured. System installation was completed in September 1975. After 12 months of data gathering, the design/performance characteristics will be analyzed and the findings and recommendations reported to ERDA. (MCW)

GEOTHERMAL

10888 GEOTHERMAL ENERGY DEVELOPMENT. HEARING BEFORE THE SUBCOMMITTEE ON ENERGY RESEARCH AND WATER RESOURCES OF THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS, UNITED STATES SENATE, NINETY-FOURTH CONGRESS, FIRST SESSION. Washington, DC; Committee on Interior and Insular Affairs (1975). 518p.

Delays in leasing and loan guarantee programs for geothermal research and development were the subject of committee hearings chaired by Senator Frank Church. Fourteen persons representing the Idaho Raft River Cooperative and the Bureau of Land Management made statements offering reasons for the delays, including: (1) ERDA has been indecisive and reluctant to proceed; (2) the Raft River project has a complex land pattern and private ownership; (3) Raft River has leases to be renewed and no bases for negotiation until ERDA underwrites some of the research risks; (4) ERDA encouraged Idaho to proceed with two years of successful exploratory drilling and has since delayed funds for further work; and (5) Pacific Northwest geothermal projects have been delayed by environmental and legal constraints, and financing and technical problems. ERDA representatives responded that more information and orderly planning are needed before continuing. New technology must be developed, and ERDA prefers a deliberate approach. (DCK)

OTHER

REFER ALSO TO CITATION(S) 10401, 10846

10889 (AECL—5109) **Assessment of the utilization of waste heat in greenhouses.** Iverson, S.L.; Prowse, D.R.; Campbell, J.D. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Jan 1976. 112p. Scientific Document Distribution Office, Atomic Energy of Canada Limited, Chalk River, Ontario, Canada KOJ 1JO $7.00; NTIS (U.S. sales only) $5.50.

The economic feasibility of utilizing waste heat from the moderator circuit of the CANDU G-2 reactor to heat greenhouses was examined. Three waste heat recovery systems were compared to a conventional gas-fired em. Each waste heat recovery systems involved the recirculation of warm light water from modified moderator heat exchangers through a distribution system to finned-tube heat exchangers in the greenhouses. The distribution system was assumed to service an 8 or 10 hectare (20-25 acre) greenhouse vegetable industry located immediately outside the 914 m reactor exclusion zone. Two greenhouse configurations were evaluated, one consisting of individual houses connected by a corridor to form 4047 square meters (1 acre) units while the other was a single roof covering 4047 square meters. The lowest calculated heating and ventilation costs for waste heat systems were $9.55 per year per square meter of growing surface for the climate of Winnipeg, Manitoba. A conventional greenhouse heated by natural gas at about $1.50 per 1000 standard cubic feet would experience the same annual heating costs. Three potential improvements to the waste heat utilization system were discussed, each of which would make the system economically competitive at current natural gas prices. Since the price of natural gas is expected to increase above its current level, and since an unfilled, expanding demand for greenhouse-grown produce exists in Canada, the concept of waste heat utilization in greenhouses merits further development. (32 references) (auth)

10890 USE OF SOLID WASTE AS A FUEL BY INVESTOR-OWNED ELECTRIC UTILITY COMPANIES. PROCEEDINGS OF THE EPA/EDISON ELECTRIC INSTITUTE MEETING HELD MARCH 5-6, 1975, IN WASHINGTON, D.C. Lowe, R.A. Washington, DC; Environmental Protection Agency (1975). 33p. Solid Waste Information, U.S. Environmental Protection Agency, Cincinnati, OH 45268.

Over 100 utility representatives and Federal, state, and local government officials participate in this conference, which was held to discuss factors relating to a utility's decision to use solid waste as a fuel. Following the keynote address by Dr. Donald D. Dunlop, summaries are presented of the four workshop sessions: Technical Aspects; Air Pollution; Economics and Financing; and Contract Negotiating and Contract Terms. Technical problems include incomplete homogenization of the waste fuel; variability of moisture content, ash content, and heating value; and the particle size. Air emission tests of the effect of refuse firing have been inconclusive. Using solid wastes for fuel is economically feasible in many instances, and investor-owned utilities are considered a good market. The basic economic questions concern who pays for and who assumes responsibility for the capital investment. Cooperation and understanding between supplier of wastes (communities) and user (utility) are thought to be essential, but responsibilities and entitlements of both must be expressed in precise contract terms. (BYB)

ELECTRIC POWER

REFER ALSO TO CITATION(S) 10464, 10830

10891 (NP—20656) **Brief of the Federal Energy Administration before the Public Service Commission of the State of Minnesota in the matter of the application of Northern States Power Company for authority to increase rates for electric utility service in Minnesota. Docket No. ER2-1.** Montgomery, R.E. Jr. (Federal Energy Administration, Washington, D.C. (USA)). 23 Sep 1975. 13p. TIC.

In response to an application for permanent rate increases, the Federal Energy Administration urges the Minnesota Power Commission to institute structural rate reforms based on peak load/time of day. These reforms would be in keeping with national energy policy and economic efficiency. With load management programs, existing equipment is adequate. Customers would be offered initiatives to reduce their bills and the opportunity to choose the level and timing of energy according to their needs and ability to pay. Three key elements in a demand/usage management program are: (1) rates based on marginal costs; (2) load control devices to raise load factor from 62% to 69%; and (3) clear communication of price signals to customers. (DCK)

10892 (NP—20663) **Feasibility and benefits of a public power corporation for Massachusetts.** (Massachusetts Public Power Corp. Study Commission, Boston (USA)). Feb 1975. 22p. TIC.

Financing advantages available to a public power corporation would provide a cost advantage over private utilities. Savings

in financing costs would be 32.6% (4.5 mills per kWh) using tax exempt bonds, 15.9% (2.2 mills per kWh) with taxable bonds, and 18.5% (2.5 mills per kWh) with a combination of 15% tax exempt and 80% taxable bonds. Savings to the ultimate consumers would be about $92 million in 1985. In determining these figures, it is assumed that equally efficient management, skilled workers, and similar operating costs exist for both public and private plants. Public power advantages include stability in times of economic stress and supply shortages, and independence to make the long-term decisions needed for energy conservation and environmental protection. Potential disadvantages could arise from ill-conceived legislation, lack of responsiveness to public views, or excessive political pressure. Serious consideration and national debate on a cooperative private/public effort in financing, constructing, and operating power plants are recommended. (DCK)

10893 (NP—20672) **Electric power pricing and the National interest. Testimony of Douglas C. Bauer before the Public Service Commission of New York. Case No. 26806.** Bauer, D.C. (Federal Energy Administration, Washington, D.C. (USA). Office of Energy Conservation and Environment). 11 Aug 1975. 22p. TIC.

The key to a national goal of energy independence is balanced and efficient growth of the electric utility industry. Energy objectives of the Federal Energy Administration (FEA) for 1985 are: (1) higher efficiency of generator fuels to increase capacity factor from 49% to 62% and load factor from 57% to 69%; (2) accelerated development of coal and nuclear generation from the present 50% to 69% of kWh output; (3) oil used in electric power generation reduced by 1 million barrels; (4) end use fuel switching from oil and natural gas to coal and nuclear energy to increase electric consumption efficiency 10%; and (5) reformed rate structures to peak load/time of day pricing. Aggressive load management and other conservation programs should improve utility financial situations and still allow a 5% sales growth while saving $48 billion in plant expansion capital. FEA will be involved in demonstration projects during the transition period. (DCK)

10894 (NP—20673) **Testimony of Richard S. Bower before the Public Service Commission of New York. Case No. 26806.** Bower, R.S. (Dartmouth Coll., Hanover, N.H. (USA). Amos Tuck School of Business Administration). 11 Aug 1975. 40p. TIC.

New pricing methods can be based on adequacy, fairness, and efficiency for both consumers and utility companies. Incremental costs, e.g., time of day or season, should be the basis for planning rate structure, with customers paying the full cost of services. In states where energy is pooled among utility companies, incremental costs should be measured at the pool level. A peak load pricing structure, which would allow customers to respond to price signals with adjusted demand, could begin at once. A step by step transition could begin with pricing based on average past base loads and adjusted after experience and research data are analyzed. Implementation efforts will include special metering equipment and contracts for interruptible service. Consumer response will tend to spread consumption to off-peak hours, change the mix of appliances and equipment, and institute conservation efforts to limit kilowatt consumption. (DCK)

10895 (NP—20674) **Technological alternatives for metering and for load management. Testimony of Thomas Laaspere before the Public Service Commission of New York. Case No. 26806.** Laaspere, T. (Dartmouth Coll., Hanover, N.H. (USA). Thayer School of Engineering). 11 Aug 1975. 42p. TIC.

Time/demand rates affect load management when customers are encouraged to change their patterns of electric consumption. The cost of load management metering equipment using time switches, radios, or ripple control will be substantially higher than the $20 single phase watthour meters now used in the U.S. Options already available include: dual register watthour time switches, which cost about $71 and require manual adjustments; radio control systems, which are good for control of urban water heating but not for all equipment; and a European one-way ripple system, which uses a power grid to transmit coded audio-frequency signals and seems to be the most reliable and flexible system. Tests are underway on two-way ripple, over-the-phone metering, magnetic cartridge recorders, and other systems. Costs, up to $400 per unit, increase with the complexity and comprehensiveness of the system. European experience indicates that consumers respond quickly to rate changes based on peak load demand management, and the high cost of complex equipment is quickly made up with reduced energy consumption and lower rates. (DCK)

10896 (NSF—75-500) **Assessment of energy parks vs. dispersed electric power generating facilities. Final report. Volumes I and II.** (General Electric Co., Washington, D.C. (USA). Center for Energy Systems). 30 May 1975. 1260p. GPO $17.75 (2 vols.), Stock No. 038-000-00230-9.

The technical, economic, environmental, and institutional aspects of the energy park concept were examined and evaluated. Major conclusions of the study included the following: 1) energy centers are technically feasible with likely economic and other benefits; 2) in comparison to dispersed nuclear power plant sites, nuclear parks appear promising; 3) integration of the nuclear fuel cycle in nuclear parks results in advantages for special nuclear materials safeguards and security because off-site transportation of nuclear materials would be reduced; 4) transmission of bulk power from an energy center can be accomplished with current technology; 5) the reliability of power supply from energy parks and dispersed sites is comparable; 6) dispersed sites are favored when considering the environment, particularly the water supply, air pollution control, thermal effluent control, and climate effects; 7) the size of a coal-fired park would be limited by air pollution control standards and by logistical problems of coal supply; 8) in reviewing institutional issues, the potential benefits of the energy park concept seem to outweigh potential disadvantages; and 9) in order for energy parks to become a reality Federal Government action is needed. (325 references) (BYB)

10897 (NTIS/PS—75/363) **Electric power consumption: a bibliography with abstracts.** Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Apr 1975. 94p. NTIS $25.00.

Eighty-nine abstracts dealing with industrial, commercial, and residential aspects of electric power consumption and demand are presented. Topic areas cover the economics of supply as well as amount of consumption. A few abstracts cover projections of future demand and conservation measures to reduce electric power consumption. (GRA)

10898 (PB—242474) **Electricity rates and the energy crisis: a conference report. Report on the FEA-sponsored electricity rate conference held in Washington, DC, on June 19, 1974.** (Federal Energy Administration, Washington, D.C. (USA). Office of Energy Resource Development, Office of Finance and Incentives). Aug 1974. 90p. (FEA/G—75/96). NTIS.

Economic problems in the electrical utilities industry are discussed in this report. The papers contained in this volume represent a consensus at the conference held on June 19, 1974. Discussion centered on improvements in electrical utility rate structures to improve consumer equity, promote energy conservation, and provide revenues necessary for continued expansion of services. For the Federal Energy Administration, this conference represents a useful beginning in the necessary process of guaranteeing a useful role for electricity in our future. It was followed by another conference in September devoted to financing the utilities industry and conservation of electrical energy. (from Foreword)

10899 POWER GENERATION: CONSERVATION, HEALTH, AND FUEL SUPPLY. THE REPORT AND RECOMMENDATIONS OF THE TASK FORCE ON CONSERVATION AND FUEL SUPPLY TO THE TECHNICAL ADVISORY COMMITTEE ON CONSERVATION OF ENERGY, NATIONAL POWER SURVEY. Washington, DC; Federal Power Commission (1975). 220p. GPO.

A demand growth of 2.2 (rather than 3.1) trillion kWh by 1980 is advisable in light of rising energy prices, conservation programs, widespread saturation of electric appliances needing inexpensive power, and health hazards related to increased power generation. With no alternative energy sources ready for commercial production, major policy changes are needed to alter political pressures and public attitudes. Conservation programs should be expanded and air quality standards implemented. Consumers should be encouraged to avoid electric resistance heating. Natural gas use should be channeled to home and business heating and away from power generation and industry. Rate structures designed to equalize prices should pass rate increases on to consumers. Demographic data, graphs, and distribution maps are offered to support these conclusions. (45 references) (DCK)

10900 ELECTRIC UTILITY RATE DESIGN STUDY: PLAN OF STUDY. Palo Alto, CA; Electric Power Research Institute (1975). 40p. Electric Power Research Institute, 3412 Hillview Ave., P.O. Box 10412, Palo Alto, CA 94303.

A phased program for analyzing electric utility rate structures would include: (1) assessment of goals, past accomplishments, and price elasticity; (2) assessment of both conceptual and mechanical tools with a review of costing theory; (3) assessment of what data and research are still needed; (4) cost benefit analyses; and (5) compromises in objectives to bring benefits in line with costs. Interim progress reports and a final comprehensive evaluation will reveal interrelationships of these assessments in such areas as different pricing structures for smaller customers, peak load pricing, electronic metering, penalty pricing, and customer responses. (DCK)

10901 ELECTRIC UTILITY RATE DESIGN STUDY: ORGANIZATION AND FUNCTIONS. Palo Alto, CA; Electric Power Research Institute (1975). 37p. Electric Power Research Institute, 3412 Hillview Ave., P.O. Box 10412, Palo Alto, CA 94303.

A plan to review electric utility rate structures and recommend needed R and D is outlined in this report. Emphasis will be placed on peak load/time of day studies. An organizational chart is followed by job descriptions for the Executive and Project Committees, Executive Director, Consultants, and Task Force Committees. Names and addresses of participants are listed by committee. (DCK)

10902 DYNAMIC MODEL OF THE UNITED STATES ELECTRIC UTILITY INDUSTRY: 1950 TO 2010. Ford, A. Hanover, NH; Dartmouth College (1975). 305p. Research Program on Technology and Public Policy, Thayer School of Engineering, Dartmouth College, Hanover, NH 03755.

A system dynamics model is constructed to assist in the formulation of policy in the electric utility industry. The usefulness of system dynamics for long-term policy analysis is contrasted with the techniques employed in nine major energy studies. Among the techniques examined are linear programming, input-output analysis, and econometrics. The model described in the report reproduces the following patterns of behavior when simulated over the period from 1950 to 1975: the generally satisfactory performance of the industry during the 1950s and early 1960s (declining price of electricity, increasing rate of return, and ample reserve capacity); the unsatisfactory performance of the late 1960s and early 1970s (increasing price of electricity, insufficient rate of return, and cutbacks in the construction of new generating capacity); the historical pattern of interfuel competition between hydro, nuclear, coal, and oil and gas in the industry; and the growth in SO_2 emissions coupled with the enactment of sulfur content regulations. The model is used to test a variety of policies. The report concludes that regulatory changes, load management, and conservation are effective in reducing the price of electricity, reducing SO_2 emissions, providing sufficient rate of return to utilities, and insuring that adequate generating capacity is constructed to satisfy future demand for electricity. (129 references) (auth, abstract modified)

10903 Energy investments and ways of financing them. Diel, R. (Dresdner Bank A.G., Duesseldorf (F.R. Germany)). *Atomwirtsch., Atomtech.;* **20**: No. 9, 409-411(Sep 1975). (In German).

The energy investments to be financed within the framework of the Federal Republic's energy program require a growing proportion of external financing. The lending possibilities here are, however, also bound to the general regulations of the financial system, where the credit solvency of the borrower, i.e. the earnings of the electricity industry, is a major criterion. Considering the promising market situation of the electricity industry, an elevation of the present credit line and a relaxation of the demands made on the balance relations should be justifiable. In this case, the problems of financing cannot be solved by the exclusive application of conventional methods. (DE)

10904 Federal Power Commission, Bureau of Power staff report on 1975-76 winter load-power supply situation, contiguous United States. *FPC News;* **8**: No. 49, 8-56(5 Dec 1975).

Projected peak loads for the 1975-1976 winter can be met by existing utility facilities in all areas of the U.S. Reserve margins will be 45.2% (148,762 megawatts) of the estimated peak load. Delays in nuclear plant construction and fossil fuel shortages will cause a problem if electric load growth returns to previous rates. In a series of tables, utilities in each region are analyzed to show their anticipated capacities and peak loads. (DCK)

10905 1974 statistics on municipally owned electric utilities. *FPC News;* **9**: No. 4, 1-3(23 Jan 1976).

In 1974, the Federal Power Commission reports, 486 municipal electric utilities sold 174.32 billion killowatt-hours to 8.1 million customers for a total revenue of $3.29 billion. Residential customers purchased 37.1% of the kWh and accounted for 11.8% of the customers and 40.5% of the revenue. Average sales to residences were 9,810 kWh, with $190.18 revenue at $1.94/kWh. Commercial and industrial customers accounted for 53.2% of the kWh, 11.8% of the customers, and 49.4% of the revenue. Average sales were 102,787 kWh with $1,701.47 revenue at $1.66/kWh. The remainder, including an additional 10.4 billion kWh for resale, went to other customers. Utility plants accounted for 77% ($10.56 billion) of total municipal utility assets. Steam generating plants produced 75%, hydraulic 18.7%, internal combustion engines 3.6%, and nuclear 2.7% of the total. (DCK)

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 10840, 10856, 10864, 10876, 10890

10906 (EPA—600/3-76-002) **Bioenvironmental impact of a coal-fired power plant. First interim report, Colstrip, Montana, December 1974.** Lewis, R.A.; Lefohn, A.S. (Environmental Protection Agency, Corvallis, Ore. (USA). National Ecological Research Laboratory). Jan 1976. 117p. NTIS.

In June 1974, the National Ecological Research Laboratory initiated a field program in southeastern Montana. The purpose of this program is to assess the effects of a coal-fired power plant on a terrestrial environment. Numerous investigators have worked together on this project to establish a baseline investigation to characterize the environment around the plant prior to operation. This report is a summary of activities from June through October, 1974. The overall objectives, rationale, and design of the project are outlined. Recommendations regarding further actions on any of the components of this program are also included. The paper serves primarily as a status report to the scientists and managers who have been following the project since its inception in March, 1973. (auth)

10907 (FEA/D—75/585) **Analysis of the impact on the electric utility industry of alternative approaches to significant deterioration. Volume I. Executive summary. Volume II. Technical support document.** (Federal Energy Administration, Washington, D.C. (USA)). Oct 1975. 201p. NTIS.

A comparison is made of EPA (Environmental Protection Agency), House, and Senate approaches to preventing significant deterioration by electric utilities. Each group sets specific pollution levels which cannot be exceeded by major new sources. Areas are classified Class I through III according to planned land use and the amount of permissible energy and industrial growth. Detailed comparisons are tabulated by issue and accompanied by technical support data. Major conclusions are: (1) construction of new coal-fired power plants will not be prevented; (2) siting of coal-fired plants will be affected by the extent of Class I area; (3) water resources of Class I areas, which are not evenly distributed, may be affected by power plant cooling; (4) a 1000 MW coal-fired plant could be built on flat terrain; (5) lower-sulfur coal and a scrubber will be needed if terrain within 15 miles is 500 ft. above a stack; (6) House standards for SO_2 are more restrictive; (7) 1000 ft. stacks will meet Class II standards in non-flat terrain; and (8) the EPA plan is more flexible in allowing reclassification from Class II to III. (DCK)

10908 Federal Power Commission, Bureau of Power Staff Report: proposed generating capacity additions, 1975-1984. *FPC News;* **8**: No. 50, 2-7(12 Dec 1975).

A 10-year trend in projected additions to generating capacity indicates larger units and a movement away from fossil to nuclear-fueled units. Although more than twice as many fossil-fueled as nuclear units are planned, the percentage increase is down. There is no clear choice of fuel for fossil units, possibly because of cost and supply uncertainties. The 1,985 projected fossil-fueled units will produce 49.33% of total capacity, 87.57% of which will be steam powered. Non-fossil-fuel projections are for 46.82% of capacity, with 86% nuclear steam. One-fourth of the new capacity will be in the southeast, with a third of the addition nuclear. Highest percentage (81.2%) of fossil-fueled capacity will be in the mid-continent and the highest percentage (65.34%) of non-fossil-fueled in the northeast. Major fossil fuels will be coal (64.81%), oil (22.5%), gas (3.88%), and 8.81% other. Of the nuclear units, more pressurized water reactors will be in use than boiling water or high temperature gas cooled reactors. (DCK)

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 10447

10909 (PB—247141) **Electric power transmission and distribution systems: costs and their allocation.** Baughman, M.L.; Bottaro, D.J. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jul 1975. 44p. (MIT-EL—75-020). NTIS $4.00.

Transmission and distribution (T and D) costs, representing 34% of the total cost of power, are analyzed to determine their role in allocating future costs for electricity. Equations are set up to compare installation, operation, and maintenance for light users (residential-commercial) with heavy industrial users. Distribution lines average $26,000 per pole mile, with underground wires two

to four times that. Sophisticated pricing systems will increase the costs of billing and metering in the future. T and D represents 70% of the cost of power delivered to light users and 45% to heavy users. Transmission line installation accounts for 50% and 60% respectively for those figures, with regional variations. Cost of building and operating the distribution system is 0.9 cents/kWh higher for the light users and establishes the higher rate allocation. (DCK)

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 10769, 10772, 10774, 10775, 10777, 10778, 10782, 10801, 10802, 10804, 10805, 10806, 10812, 10836, 10897

10910 (NTIS/PS—75/854) **Car pools: a bibliography with abstracts.** Adams, G.H. (National Technical Information Service, Springfield, Va. (USA)). Dec 1975. 21p. NTIS $25.00.

Twenty-one abstracts are presented of studies on the feasibility, methodology, and benefits of cooperative automobile use, or car pooling, in urban areas. The principal problems considered are traffic congestion, air pollution, and fuel shortages, along with the associated advantages of mobility improvement, environmental protection, and energy conservation. Several proposals are presented, such as exclusive bus and car pool lanes, community hitchhiking, Government agency preferential treatment of carpoolers, work-destination charts and listings, and computer matching of journey-to-work data. Incentives to gain motorist support, as well as difficulties to be handled regarding work shifts and travel distances are discussed. (auth)

10911 (PB—240012) **Energy intensity of barge and rail freight hauling. Research report.** (Illinois Univ., Urbana (USA). Center for Advanced Computation). May 1974. 18p. (UIUC-CAC-DN—74-127). NTIS $3.25.

This paper presents results of an energy comparison per ton mile of competing rail freight vs. inland barge freight, including the effects of circuitry and the use of probable competing rail lines instead of national average rail data. (GRA)

10912 (PB—240866) **Immediate impact of gasoline shortages on urban travel behavior.** Peskin, R.L.; Schofer, J.L.; Stopher, P.R. (Northwestern Univ., Evanston, Ill. (USA)). Apr 1975. 151p. NTIS.

In response to the gasoline shortage of 1974, a small-scale home interview survey was conducted in an attempt to identify and define (1) changes in the price elasticity of demand for gasoline, (2) procedures for characterizing gasoline supply in travel behavior models, and (3) key implications for the development of transportation and urban design policies. The survey, conducted in the northern suburbs of Chicago among households with a high level of automobile ownership, used a questionnaire designed to measure changes in travel behavior, attitudes, and perceptions as a result of the increased price and decreased availability of gasoline. Analysis showed that price was not an important consideration in automobile use while the supply of gasoline was constrained. Use of public transportation was the least common trip-making decision, while combining trips was most common. There was a significant reduction in non-work trips during the shortage. No change in the desired location of home or work was found. This study suggests that only an artificially constrained supply of gasoline, rather than modest increases in price, seems a promising control for consumption. Policy implications for urban planners and public officials center around educating the public about more energy-efficient modes and providing incentives to encourage their use. (GRA)

10913 (PB—245012) **Effect of the fuel shortage on travel and highway safety.** Cerrelli, E.C. (Department of Transportation, Washington, D.C. (USA). National Highway Traffic Safety Administration). Aug 1975. 64p. (DOT-HS—801715). NTIS.

The basic objective of this report is to bring together the information which has become available on the effect of the most recent fuel shortage. The report summarizes the most important background events and presents fairly detailed data describing the effects of the fuel shortage on the amount and characteristics of automotive travel. Estimates of the derived safety benefits and fuel conservation are presented in the report and are based on a large body of data for both years 1973 and 1974. Major emphasis is placed in assessing the safety and conservation effects of the 55 mph national speed limit. A limited list of both qualitative and quantitative conclusions are also included. (GRA)

10914 (PB—245194) **Study of the energy- and fuel-use patterns in the nonferrous metals industries.** Hall, E.H.; Bartlett, E.S.; Buttner, F.H.; Conkle, H.N.; Drennen, D.C.; Ellzey, V.W.; Fels, M.; Frazier, N.A.; Hallowell, J.B.; Mezey, E.J.; Flinn, J.E. (Battelle Columbus Labs., Ohio (USA)). 31 Dec 1974. 322p. (FEA/EI—1658). NTIS $10.00.

The patterns of energy use in 10 SIC's within the nonferrous metals industries are studied. Total energy use, broken down by fuel type, is estimated for each of the 10 industries and for major processes within each industry. A review of each industry based on company responses is presented with respect to: the potential for fuel switching, opportunities for short-term conservation, sources of fuels and energy supply, levels of fuel stocks, key constraints on industry operations, and industry products which may be critical to the needs of Project Independence. The 10 industries included in the study are: primary copper; primary lead; primary zinc; primary aluminum; primary nonferrous metals; secondary nonferrous metals; copper rolling and drawing; aluminum rolling and drawing; nonferrous rolling and drawing; and nonferrous wire, drawing and insulating. Also included are industry projection details. (34 references) (auth, abstract modified)

10915 (PB—246357) **Energy use patterns in metallurgical and nonmetallic mineral processing. Phase 5. Energy data and flowsheets: intermediate-priority commodities.** (Battelle Columbus Labs., Ohio (USA)). 16 Sep 1975. 241p. (BM-OFR—96-75). NTIS.

The energy consumption patterns of 27 intermediate-priority commodities are analyzed. These commodities and their appropriate primary products were originally selected for this category either because of an expected fairly high total annual energy requirement to produce or because of the fairly large tonnage produced each year. All of these commodities are important basic industrial materials and, therefore, this detailed energy appraisal should be of particular value in assessing the national pattern of energy consumption. This study differs from the usual energy analysis, because it includes estimated energy values for mining and beneficiation, consumable raw materials, transportation, and fuels and electrical energy. The magnitude of imports of ores and concentrates is given. The level of such imports indicates the degree of U.S. dependence on foreign sources for basic raw materials. Imports of partially or completely processed primary products are shown. Total energy required for 1973 U.S. consumption of primary products is given. (198 references) (auth)

ENERGY CONVERSION

REFER ALSO TO CITATION(S) 10390, 10435, 10760, 10762, 12248

10916 **Prestressed glass electrical power source.** Newsom, M.M. (to U.S. Energy Research and Development Administration). US Patent Application 560,427. Filed date 20 Mar 1975. 7p.

An electrical power source which comprises a body of prestressed glass having a piezoelectric transducer supported on the body in direct mechanical coupling therewith is described.

MHD GENERATORS

DESIGN AND DEVELOPMENT

10917 (FE—1208-1) **Development program for MHD power generation. Interim technical report June 1974.** (Avco-Everett Research Lab., Everett, Mass. (USA)). Jun 1974. 250p. Dep. NTIS $8.00.

A total of 33,000 kilowatt hours of accumulated operating experience has been built up on the Mark VI MHD generator experiment. A total absence of arcing during the last 68 hours indicates that this major determinant of long-duration reliability has been brought under control, and a new Avco-designed burner has been put in service which has made possible, on a routine basis, power-levels in the Mark VI of from 400 to 500 kilowatts. A metal tubular air preheater and compressor have been ordered for the purpose of reducing the hourly consumption of liquid oxidizer, thus allowing more hours of operation between refills. Testing of the high-temperature air heater has also yielded highly satisfactory results. To date, air preheat temperatures of 3000°F and higher have been reached in continuous cyclic operation for more than 600 hours. Alumina cored brick is the heater matrix and the mode of operation corresponds to separate firing. Air preheat temperature strongly influences the overall efficiency of an MHD plant and an efficiency of between 55-60 percent is possible with the performance obtained to date. Detailed analysis of the radiation cool-

ing and kinetics of the MHD generator exhaust gas in the radiant section of the downstream boiler, have shown that the level of NO/sub x/ can be reduced to a fraction of the corresponding EPA standard in a furnace of reasonable size.

10918 (AD-A—008343) **Investigation of characteristics of magnetohydrodynamic generators in industrial power plants.** Popyrin, L.S.; Pshenichnov, N.N.; Rogachev, A.P.; Sokolskii, A.G.; Khokhlov, L.K. 27 Oct 1974. Translation of Referativnyi Zhurnal. Fizika; No. 12, 288-307(1972). (FSTC-HT—23-0121-75). 36p. NTIS $3.75.

The authors studied a magnetohydrodynamic generator of the Faraday type with segmented electrodes in order to determine the main characteristics of the generator, including characteristics relevant to engineering-economic indices. The different variants were calculated using a mathematical model developed at the Power Institute of the Siberian Branch of the USSR Academy of Sciences which was programmed for the BESM-4 electronic digital computer. (GRA)

10919 **Commercial MHD power generation development.** Shanklin, R.V. III. (Systems Research Labs., Inc., Dayton, OH). pp 29-34 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

The MHD process and its use in an advanced power cycle is reviewed. Within this context the expected performance is considered and comparisons made with alternative systems. Environmental considerations are also discussed. Some recent experimental advances are presented followed by a brief discussion of the plan recently formulated by the government for the national development of MHD. The paper concludes with a discussion of some of the economic ramifications necessary in any consideration of coal fired MHD plants. (WHK)

PERFORMANCE AND TESTING

10920 **A theoretical study of the energy output of two magnetohydrodynamic generators.** Vergnes, J. (Centre Universitaire de Saint-Denis, 974 - Reunion (France)). *C. R. Hebd. Seances Acad. Sci., Ser. A, B;* **280**: No. 23, 707-709(16 Jun 1975). (In French).

The outputs of two alternating-current generators consisting of rectangular conduits which contain an electroconducting viscous fluid and are subjected to a uniform magnetic induction field are compared. This study supposes that the electric circuit is closed by a resistance R. (FR)

MATERIALS, COMPONENTS, AND AUXILIARIES

10921 (BNWL-B—463) **Characterization and evaluation of materials for the US—USSR MHD program. Progress report, July—September 1975.** Bates, J.L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. vp. Dep. NTIS $7.60.

Characterization of MHD insulator and electrode materials was initiated in support of the International US-USSR MHD Power Generation Program, U-02 Phase I. MgO insulators and five zirconia base electrodes containing CeO_2 and Y_2O_3 additions are being characterized. Characterization includes thermal diffusivity/conductivity, thermal expansion, composition and microstructure. The microstructural examinations were completed and thermal diffusivity of the electrodes and insulators were measured. 17 figures. (auth)

EHD GENERATORS

10922 (AD-A—008182) **Research on charged alkali colloids for aerospace vehicle and ground based power generation. Final report, 10 Feb 1972-7 Feb 1974.** Solbes, A.; Martinez, M. (Massachusetts Inst. of Tech., Cambridge (USA). Space Propulsion Lab.). Jan 1975. Contract F33615-72-C-1258. 121p. NTIS $5.25.

Results of the study of the fundamental physical processes and measurement of properties aimed at predicting the performance of two fluid liquid metal vapor EFD converters are presented. The condensation studies indicate that substantial alkali boiler concentrations (30 percent cesium) are required to produce appreciable homogeneous nucleation in alkali amalgam vapors. The case of heterogeneous condensation about ions is also studied. The results of breakdown studies for amalgam vapor mixtures with helium, nitrogen, and hydrogen show the latest gas to be the most desirable choice for efficient conversion. Generator studies indicate the existence of contact charging of liquid mercury droplets with surfaces of higher work function. The behavior of the generator is seen to depend strongly on the amount of recirculated condensate and current. An analysis is presented for the efficiency of neutralization of charges at the collector. (GRA)

THERMOELECTRIC GENERATORS

DESIGN AND DEVELOPMENT

10923 (AD/A—005205) **Thermoelectric devices, being blown through with a substance in the direction of heat flow.** Kotyrlo, G.K.; Shchegolev, G.M. Translated from *Teplofiz. Teplotekh.;* No. 19, 132-135(1971). 10p. (FSTC-HT—23-1635-73). NTIS $3.25.

10924 (AD/A—005209) **Semiconductor thermoelectric batteries for air conditioning.** Byalekdinov, M.F.; Efimov, V.A.; Lupanov, B.S.; Khorunzhin, Yu.P. Translated from *Kholod. Tekh.;* No. 7, 20-23(1973). 7p. (FSTC-HT—23-0165-75). NTIS $3.25.

MATERIALS, COMPONENTS, AND AUXILIARIES

10925 (AD-A—008253) **Effect of deformation on the thermoelectric properties of Bi_2Te_3—Bi_2Se_3.** Kuliev, A.Z.; Okhotin, A.S.; Asadov, D.A.; Kakhramanov, K.Sh. 20 May 1974. Translation of Teplofizich. Svoistva Tverd. Tel, Baku, 1971, p30-33. (FSTC-HT—23-423-74). 6p. NTIS $3.25.

The effect of an external unilateral pressure up to 250 kgf/sq cm on electrical conductivity, thermal emf and thermal conductivity of n-type Bi_2Te_3-Bi_2Se_3 was investigated over the 300 to 550 K temperature range. Electrical conductivity at 300 K increases linearly up to 100 kgf/sq cm, then decreases sharply, but this is not observed at higher temperatures. This may be due to a decrease in activation energy of impurities, with electron scattering as a consequence of new defects at higher pressures. The lattice and electron components of thermal conductivity show a similar maximum at 100 kgf/sq cm. Changes in electrical conductivity and thermal emf as a function of number of stress cycles were measured and are presented. (GRA)

APPLICATIONS

REFER ALSO TO CITATION(S) 10373

FUEL CELLS

DESIGN AND DEVELOPMENT

10926 (AD-A—009587) **Fuel cell stacks. Semiannual technical report, 27 Jun-27 Dec 1974.** Baker, B.S. (Energy Research Corp., Bethel, Conn. (USA)). Apr 1975. Contract DAAK02-74-C-0367. 32p. (ERC—7396-S). NTIS $3.75.

Processes for the manufacture of phosphoric acid fuel cell components are described. Electrodes, matrices, and bipolar gas distribution plates for use in fuel cells with an active area of approximately 0.4 sq. ft. were fabricated. Samples from these components were tested in fuel cells, and all items have demonstrated lifetimes in excess of 1000 hours. Performance data are given. (GRA)

MATERIALS, COMPONENTS, AND AUXILIARIES

10927 **Activated stable oxygen electrode.** Zimmermann, G.; Schonborn, M.; Magenau, H.; Jahnke, H.; Becker, B. (to Robert Borsch GmbH). US Patent 3,930,884. 8 May 1974. Priority date 25 May 1973, German, Federal Republic of (F.R. Germany). vp.

A stable oxygen electrode which retains its useful catalytic activity over a long service life is described comprising an electrode carrier containing an activated transition metal chelate of 5,14-dihydrodibenzo(5,9,14,18)-tetraaza(14)-annulene, said activated metal chelate having been activated by heating in an inert gas atmosphere at a temperature between about 600°C and 1000°C for a minimum time of 5 minutes.

10928 **Method of making a fuel cell electrode.** Baker, B.; Klein, M. (to Energy Research Corp.). US Patent 3,943,006. 1 Oct 1974. vp.

A method for use in producing electrode structure for fuel cells is described comprising the steps of: a) blending particles of noble metal black, particles of dry polytetrafluoroethylene and particles of a soluble bulking agent in a liquid in which said bulking

agent is insoluble, said polytetrafluoroethylene constituting at least 10 percent of the combined weight of said noble metal black and said polytetrafluoroethylene; b) filtering liquid from said blend to form a filtered mixture; c) subjecting said filtered mixture to rolling forces to form a sheet of fibrillated polytetrafluoroethylene containing noble metal black and bulking agent; and d) removing the remainder of said liquid from said sheet.

PHOTOVOLTAIC CONVERTERS

REFER ALSO TO CITATION(S) 10405

POWER CYCLES

BRAYTON

REFER ALSO TO CITATION(S) 10437

RANKINE

REFER ALSO TO CITATION(S) 10372

10929 **Comparison of helium, potassium, and cesium cycles.** Fraas, A.P. (Oak Ridge National Lab., TN). pp 486-495 of In Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).

See CONF-750812—.

STIRLING

REFER ALSO TO CITATION(S) 10362

OTHER

10930 **Energy conversion system.** Banks, R.M. (to U.S. Energy Research and Development Administration). US Patent 3,913,326. 21 Oct 1975. Filed date 11 Apr 1974. 10p.

PAT-APPL-459,991.

An engine for converting thermal energy to rotary mechanical work by alternating changes in configuration of thermally responsive elements composed of a thermal memory material is described. The elements are pivotally interconnected between a stationary pivot and a rotor which rotates about a fixed axis disposed eccentrically of the stationary pivot. Alternate heating and cooling of the thermally responsive elements to temperatures above and below, respectively, the predetermined critical temperature results in a torque about the fixed axis of the rotor.

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 10760, 10761, 10766, 10773, 10779, 10788, 10801, 10802, 10804, 10806, 10807, 10808, 10809, 10814, 10819, 10823, 10831, 10834

10931 (COO—2547-1) **Planning for a program design for energy environmental analysis. Progress report.** Denton, J.C. (Pennsylvania Univ., Philadelphia (USA). National Center for Energy Management and Power). [nd]. Contract AT(11-1)-2547. 6p. Dep. NTIS $3.50.

The work reported is focused on determining the proper scope of a regional assessment study program suitable for BER/ERDA. Within the tentative scope selected, a tentative set of purposes, goals, and objectives is identified for a preliminary specification of a geographical region. The initial specification of the region includes the states of Pennsylvania, New Jersey, Delaware, Maryland, and Virginia. The tentative scope of considerations for the regional assessment study program encompasses the interacting facets of environment, energy, and economic well-being of the region with the goal of reconciling these facets within the decision framework of the region. (auth)

10932 (LBL—3299) **Towards more productive energy utilization.** Schipper, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1 Oct 1975. Contract W-7405-eng-48. 82p. (CONF-760217—2). Dep. NTIS $5.00.

From Annual meeting of American association for the advancement of science; Boston, Massachusetts, United States of America "USA" (24 Feb 1976).

The nature of energy use and strategies which increase the efficiency of energy use are discussed. Measures of physical and economic efficiency are discussed. It is suggested that specific energy requirements of tasks in the United States could be reduced by 33 to 40 percent over the next few decades at cost savings to energy users. Most of the energy conservation strategies required would have only a slight effect on life style, as well. In addition to saving energy and money, higher energy use efficiency raises the total demand for labor in the economy, lowers pollution, reduces the total capital requirements of future energy activities, and allows society to proceed cautiously with risky or marginal energy sources. Many barriers to more efficient energy utilization exist, barriers whose solution are socio-economic or political rather than technical. These barriers are reviewed, and some suggestions are made which would allow society to overcome them in seeking to use energy more efficiently than today.

BUILDINGS

REFER ALSO TO CITATION(S) 10445, 10763, 10769, 10770, 10800, 10812, 10841, 10844

10933 **Operational reliability of district heating networks and methods of increasing it.** Gromov, N.K. *Therm. Eng. (USSR) (Engl. Transl.)*; 22: No. 2, 58-64(1975).

Translated from Teploenergetika; 22: No. 2, 54-59(1975).

Already-operational systems of hot water supply must always be taken into account when treating questions of the development of systems of centralized heat supply of towns. Of the three main links in the chain of heat supply of towns, the heat source, the heating network, the consumer, the least reliable (from the standpoint of uninterrupted heat supply) is the middle link - the underground pipeline. Its required degree of reliability can only be ensured by the provision of back-up networks. The provision of back-up facilities in extended networks is most economically and conveniently achieved with the aid of control-distribution substations with a thermal load of 30 to 50 Gcal/h, the presence of which ensures the possibility of reliable control of the network's operating conditions in both normal and emergency modes. (LCL)

RESIDENTIAL

REFER ALSO TO CITATION(S) 10768, 10771, 10772, 10776, 10777, 10810, 10885

10934 **Heat saving apparatus.** Goldsmith, M. (to Partnership of Goldsmith, Josephson, and Gulko). US Patent 3,934,798. [nd]. Filed date 1 Nov 1974. vp.

The design and operation of a forced draft home heating system in which a return plenum supplies preheated air to the furnace is described. (LCL)

SCHOOL

REFER ALSO TO CITATION(S) 10887

COMMERCIAL

10935 (PB—241095) **Energy conservation study of Veterans Administration hospitals. Stage 1. Base line survey. Final report.** (Reynolds, Smith and Hills, Jacksonville, Fla. (USA)). Feb 1974. Contract V-594P-454. 58p. NTIS $4.25.

Presented is a baseline survey that identifies and unifies all elements of energy consumption and establishes significant energy parameters at three V.A. hospitals. (GRA)

10936 (PB—241096) **Energy conservation study of Veterans Administration hospitals. Stage 2. Operational study. Final report.** (Reynolds, Smith and Hills, Jacksonville, Fla. (USA)). Feb 1974. Contract V-594P-454. 122p. NTIS $5.25.

This operational study report inspects and reviews operations of three V.A. hospitals and isolates areas of correctable losses. (GRA)

10937 (PB—241097) **Energy conservation study of Veterans Administration hospitals. Stage 3. Hospital energy control system. Final report.** (Reynolds, Smith and Hills, Jacksonville, Fla. (USA)). Feb 1974. Contract V-594P-454. 92p. NTIS $4.75.

This hospital energy control system report presents the programming specifications for a computer-based energy data reporting system to measure and compare management of energy usage for all V.A. hospitals. (GRA)

10938 (PB—241098) **Energy conservation study of Veterans Administration hospitals. Stage 4. Basic detail data for Stage 1, 2, and 3. Final report.** (Reynolds, Smith and Hills, Jacksonville, Fla. (USA)). Feb 1974. Contract V-594P-454. 327p. NTIS $9.50.

This basic detail data report includes all the raw data gathered from three different V.A. hospitals for the purpose of studying energy conservation. (GRA)

REFER ALSO TO CITATION(S) 10812

RAILWAY

REFER ALSO TO CITATION(S) 10911

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 10754, 10782, 10910, 10912, 10913, 10948

10939 (PB—240731) **The effects of the lowered maximum speed limit and fuel shortage on highway safety in North Carolina. Interim report, 1 Jul-31 Dec 1974.** Seila, A.F.; Reinfurt, D.W. (North Carolina Univ., Chapel Hill (USA). Highway Safety Research Center). Mar 1975. Contract DOT-HS-4-00897. 63p. NTIS $4.25.

The effects of the lowered maximum speed limit and other fuel conservation measures which were instituted during the fuel shortage from November 1973 to March 1974 are reported. Comparisons made between the first four months of 1974 and the same period a year earlier indicate that accidents decreased 9.5 percent, fatal accidents decreased 21.0 percent, and injury accidents decreased 12.0 percent in North Carolina. The severity of accidents was decreased during the fuel shortage, and gross exposure decreased an estimated 3.2 percent. (GRA)

SEA AND WATER

REFER ALSO TO CITATION(S) 10765, 10911

INDUSTRY

REFER ALSO TO CITATION(S) 10434, 10767, 10774, 10775, 10778, 10780, 10914

MATERIALS

REFER ALSO TO CITATION(S) 10845, 10915

EQUIPMENT AND PROCESSES

10940 (ORO—5010-1) **Bimonthly progress report.** (InterTechnology Corp., Warrenton, Va. (USA)). [nd]. Contract E(40-1)-5010. 10p. Dep. NTIS $3.50.

Progress in identifying methods for reducing natural gas consumption at the Clarksburg, W. Va. sewage treatment plant is reported. Fourteen options, including improving the efficiency of the space heating system, use of solar collectors for process heat and space heating, and recovery of the flue gas heat are discussed. Data are presented on the capital cost and gas savings estimated with each method. It is concluded that the plant modifications recommended would result in a net reduction of 2/3 of the natural gas now purchased for the sewage plant and the capital costs would be recovered in five years of operation. (LCL)

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 10889, 10940

RECYCLING

10941 (PB—239674) **Glass recycling and reuse.** Samtur, H.R. (Wisconsin Univ., Madison (USA). Inst. for Environmental Studies). Mar 1974. 106p. NTIS $5.25.

This report explores possible methods for recycling and/or reusing post-consumer glass products to determine which methods are most favorable. The report deals with: the properties of glass; glass manufacture; analyses of alternatives to direct disposal of glass products; reuse of waste glass for glass manufacture; techniques for the separation of glass from municipal refuse; the development of degradable glass containers; returnable containers; and energy consumption for each of the major components of the glass cycle. (GRA)

ELECTRIC POWER

REFER ALSO TO CITATION(S) 10864, 10898, 10909

BUILDINGS

10942 Prospects of a propagation of the long-distance heat supply. Winkens, H.P. *Energiewirtsch. Tagesfragen;* **25**: No. 8, 374-381(Aug 1975). (In German).

10 figs.; 18 refs.

The state of development and the trends of long-distance heat supplies in some neighboring countries of the FRG is reported, and the future long-distance energy demand of the FRG is predicted for various groups of consumers up to the year 2000. Heating costs from fossil fuel power plants and HTR as well as LWR nuclear power plants are compared. A program study of secondary energy systems is evaluated, and a proposal for establishing a long-distance interconnecting system in the FRG is discussed. The viewpoint that more conventional heat power plants should be built is presented. (DE)

INDUSTRY

REFER ALSO TO CITATION(S) 10767

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 10398, 10813, 10884

10943 Elimination of a solid waste problem through product recovery. Edgerley, E.; Ryckman, S.. pp 143-145 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

Laboratory studies on the recycling of waste paint sludge from automobile manufacture are described. By homogenization of the sludge followed by re-dissolution a reconstitute paint could be obtained. However the paint had inacceptable elasticity and adherence. Additional tests showed that the addition of a mixture of PVC and dioctylphthalate to the homogenized and redissolved sludge provided a material suitable for undercoating cars. This recycled mterial had better elasticity and adherence than the materials currently in use. (JSR)

10944 Economics of resource recovery. Stallings, J.W. (National Center for Resource Recovery, Washington, DC). pp 161-164 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

Data are tabulated and evaluated on the capital and operating costs of five general recovery systems, i.e., full scope materials recovery, full scope materials recovery and refuse derived fuel, refuse derived fuel alone, refuse derived fuel plus magnetic separation, and magnetic separation alone. The limitations of the data are stressed. (JSR)

10945 Ohio's solid waste action plan. Sharp, D.A. pp 165-166 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

Ohio has adopted a state policy for development of a statewide solid waste management system in order to bring about a transition to management practices for full, practical utilization of resources recovery. The objectives of the state policy are outlined, and the mechanisms for their implementation are described. The primary features of the solid waste program are discussed. (JSR)

10946 System of treating flue gas. Ziegler, D.L. (to U.S. Energy Research and Development Administration). US Patent 3,925,039. 9 Dec 1975. Filed date 18 Nov 1974. 10p.
PAT-APPL-525,042.

A system is described for treating or cleaning incinerator flue gas containing acid gases and radioactive and fissionable contaminants. Flue gas and a quench solution are fed into a venturi and then tangentially into the lower portion of a receptacle for restricting volumetric content of the solution. The upper portion of the receptacle contains a scrub bed to further treat or clean the flue gas.

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 10782

SPARK-IGNITION

REFER ALSO TO CITATION(S) 10391

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 10754

HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 10754

VEHICLE DESIGN FACTORS

BODY AND CHASSIS

10947 Significance of aerodynamics on truck fuel economy. Servais, R.A.; Bauer, P.T. (Creative Engineering Consultants and Associates, Bellbrook, OH). pp 57-61 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).
From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).
See CONF-741179—.

Substantial fuel savings can be realized by incorporating current aerodynamic concepts in the design of ground vehicles. Analysis has shown that streamlined semi-trucks traveling at highway speeds could exhibit an aerodynamic drag reduction in excess of 60 percent over contemporary shapes and a corresponding 40 percent decrease in fuel consumption. Two series of wind tunnel tests were conducted which identify new tractor shapes and modifications to existing conventional and cabover tractors that exhibit dramatic improvements in drag characteristics. In addition, these new designs will probably improve handling characteristics while reducing the aerodynamic influence of trucks on passing vehicles. A full-scale demonstration of the improved performance trucks is planned.

ENGINE SYSTEM

10948 (AD-A—009214) **A review of proposed automotive carburetor concepts for improved fuel economy. Interim report, May-Sep 1974.** Hinton, M.G.; Meltzer, J.; Iura, T.; Forrest, L.; Smalley, W. (Aerospace Corp., El Segundo, Calif. (USA). Environmental and Urban Div.). Mar 1975. Contract F04701-74-C-0075. 94p. NTIS $4.75.

A summary is given of available information pertaining to improved automotive carburetors. In particular, information is provided which depicts the development and performance characteristics of a selected number of advanced or novel carburetors which have the potential to improve automotive fuel economy. To provide a basis of perspective, a discussion of the basic requirements, construction, method of operating, and inherent limitations of conventional carburetors and induction systems is included. (GRA)

10949 (UCRL-Trans—10745) **"Electronic CAM" to control the volume of injected fuel in internal-combustion engines.** Rauenbusch, H.; Zellinger, K. Translated from *Motortech. Z.*; **34**: No. 3, 73-76(1973). 13p. Dep. NTIS $3.50.

Quick and accurate changing of the injected fuel volume characteristics in internal combustion engines is not yet possible; devices serving this purpose are not yet available. An "electronic volume-controlling cam" was therefore specially developed, which satisfies the above requirements and is particularly suitable for experimental purposes. (auth)

EMISSION CONTROL

10950 (AD-A—009281) **Evaluation of the effects of engine deterioration on gasoline exhaust emissions. Final report.** Payne, A.L. (Army Material Command, Texarkana, Tex. (USA). Intern Training Center). Apr 1975. 50p. (USAMC-ITC—02-08-75-101). NTIS $3.75.

An experiment to determine the relationship between gasoline exhaust emissions and engine deterioration is discussed. The experimental design is specifically aimed at exhaust emission trends throughout engine life. The engines used for this experiment are four 4 1/2 hp Wisconsin, Model MBKND, air cooled, reciprocating gasoline engines. The experimental techniques presented provide a good foundation for further research. (GRA)

10951 (PB—239691) **Status of industry progress towards achievement of the 1975 federal emissions standards for light-duty vehicles. Final report.** Roessler, W.V.; Iura, T.; Meltzer, J. (Aerospace Corp., El Segundo, Calif. (USA)). Jul 1972. Contract EPA-68-01-0417. 474p. (ATR—73(7322)-1). NTIS $11.50.

A compilation and assessment of all available information pertaining to the technological progress made by the automotive industry toward meeting the 1975 Federal emission standards for light-duty vehicles are presented. Important findings and conclusions are presented in the Highlights and Executive Summary sections of the report. Material related to candidate 1975 emission control systems is given in Section 2. An assessment of emission control techniques and system components (engine modifications, EGR (exhaust gas recirculation), oxidation catalysts, thermal reactors, and secondary air supply) is presented in Sections 3 through 7. Engineering emission goals and emission control system deterioration characteristics with mileage accumulation are discussed in Section 8. The interim standards proposed by the automobile manufacturers are summarized in Section 9 and maintenance, cost, safety, and production lead time aspects are briefly discussed in Sections 10 and 11. Section 12 presents a brief status report of unconventional automotive engines, including the rotary (Wankel), diesel, gas turbine, stratified charge, Rankine cycle, and Stirling cycle. (GRA)

SULFUR DIOXIDE

REFER ALSO TO CITATION(S) 10270

10952 (PB—240995) **Sulfate control technology assessment, Phase I: literature search and analysis. Task report.** Leppard, W.R. (Exxon Research and Engineering Co., Linden, N.J. (USA)). Nov 1974. Contract EPA-68-03-0497. 50p. NTIS $3.75.

A literature search was conducted to bring together and examine the literature pertaining to sulfur oxides in automotive exhaust systems, including the thermodynamic potential and kinetics of forming the trioxide. Since sulfuric acid emissions may be deleterious, the literature pertaining to removal of sulfur oxides from gaseous streams was reviewed. Stress was placed on the use of metal-oxide sorbents for this purpose. Information is presented on: (1) the thermodynamics of sulfur trioxide formation, reaction with water, and condensation; (2) possible reaction with materials in the exhaust gas or system; (3) the catalytic oxidation of sulfur dioxide on platinum catalysts; and (4) possible means of removing sulfur trioxide from the exhaust stream. (GRA)

HYDROCARBONS

10953 Transportation control plan requirements of Cincinnati and other cities. Ermenc, E.D. (City of Cincinnati, Air Pollution

Control). pp 97-101 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

Cincinnati has the doubtful distinction of being the first city in the State of Ohio to be directed to institute automotive emission testing by the US EPA. Last year, a Cincinnati emission inventory indicated that hydrocarbon sources had decreased by less than 1 percent of the reduction requirement to meet standards. The required reduction amounted to 43 percent of the present emission, whereas calculations showed approximately 42 percent could be accomplished. A reduction of 27,500 tons/year of hydrocarbons was required, including 400 tons/year attributed to automobiles, but a decrease of only 200 tons/year was attained.

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 10391, 10860

MATERIALS

10954 (ORO—3105-52) **Progress report, May 1, 1975—April 30, 1976.** (Virginia Univ., Charlottesville (USA)). 1976. Contract AT(40-1)-3105. 13p. Dep. NTIS $3.50.

New results on transport properties of ferromagnetic metals and layer structure dichalcogenides include an unusual sign reversal of the Hall effect in iron above 150 kG at 4.2°K and giant Shubnikov—de Haas oscillations in 4Hb-TaS_2. Further results were also obtained on the anomalous transport behavior in Fe-doped TaS_2 and $TaSe_2$. Negative magnetoresistance and Hall resistivity due to magnetic scattering were measured in Fe/sub x/$TaSe_2$ in fields to 220 kG and the exchange constants estimated. Magnetic susceptibility of these systems shows a Curie—Weiss behavior and values of the effective magnetic moments have been obtained. A large anisotropic susceptibility was also observed in 4Hb-Fe/sub .02/$TaSe_2$ which shows a ratio x/sub perpendicular//x/sub parallel/ ≈ 40. Raman scattering from 1T-TaS_2 showed considerable structure due to the charge density wave transition. Below the transition at ~200°K, a large number of peaks associated with optic phonons generated by the superlattice are observed. Inelastic electron tunneling spectra of a series of nucleotide molecules show that the method can be used for detailed identification of nucleotide derivatives. (auth)

10955 (AEC-tr—7297/3) **Ukrainian Physics Journal.** Translated from *Ukr. Fiz. Zh. (Russ. Ed.)*; **16**: No. 3, 419-633(Mar 1971). 220p. (TT—72-52017/03). Dep. NTIS $7.75.

A cover-to-cover translation into English of the March 1971 issue of the Ukrainian Physics Journal (Ukrainskii Fizicheskii Zhurnal, Vol. 16, No. 3) is given. Solid-state physics and properties of materials are prominent in this issue, but articles on lasers, cosmology, atomic and nuclear physics, and plasma occur as well. Items within the subject scope of NSA were cited therein from the original-language publication. (RWR)

10956 **INTERNAL FRICTION AND ULTRASONIC ATTENUATION IN CRYSTALLINE SOLIDS. VOLUME II. PROCEEDINGS OF THE FIFTH INTERNATIONAL CONFERENCE HELD AT AACHEN, GERMANY, AUGUST 27—30, 1973.** Lenz, D.; Luecke, K. (eds.). Berlin; Springer-Verlag (1975). 524p. (CONF-730844—P2).

From Conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F.R. Germany (27 Aug 1973).

Forty-five papers are presented under the following topics: interactions of dislocations with phonons and electrons, dislocation resonance and irradiation, cold work effects, and amplitude-dependent internal friction. Separate abstracts were prepared for 11 papers; ten other papers were previously abstracted as NSA 29: 03005, 03062, 03063, 03065, 03067, 10752, 10753, 16332, 16362, and 24798.

10957 **INTERNAL FRICTION AND ULTRASONIC ATTENUATION IN CRYSTALLINE SOLIDS. VOLUME I. PROCEEDINGS OF THE FIFTH INTERNATIONAL CONFERENCE HELD AT AACHEN, GERMANY, AUGUST 27—30, 1973.** Lenz, D.; Luecke, K. (eds.). Berlin; Springer-Verlag (1975). 458p. (CONF-730844—P1).

From Conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F.R. Germany (27 Aug 1973).

Forty-nine papers are presented under the following topics: phonons, electrons, and magnetic effects; point defects; and grain boundaries and phase transformations. Separate abstracts were prepared for 13 papers; ten other papers were previously abstracted as NSA 29: 03008, 03046, 03068, 03105, 10722, 13064, 13238, 16333, 24799, and 30148. (DLC)

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 10527

10958 (CONF-751165—1) **Contributions to the rare earths to science and technology.** Spedding, F.H. (Ames Lab., Iowa (USA)). 1975. 13p. Dep. NTIS $3.50.

From MS;ASM symposium on the effects of rare earths on the properties of metals and alloys; Cincinnati, Ohio, United States of America "USA" (13 Nov 1975).

This is a brief summary of some areas of science where the rare earths have already played an important role and of other areas where they are almost certain to be helpful. The discovery, abundance, separation, and properties of rare earths are discussed. It is pointed out that the rare earths comprise almost one-fourth of the known metals, and their alloys a third of the possible alloys. (DLC)

10959 (ERDA—55) **Materials Sciences Programs, FY 1975.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Physical Research). Jul 1975. 151p. Dep. NTIS $6.75.

A compilation of ERDA materials sciences programs is presented. The compilation is divided into sections in which projects are listed and funding levels are summarized. An index is included. (JRD)

10960 (UCRL—50028-75-2) **H-Division quarterly report, April—June 1975.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. Contract W-7405-Eng-48. 58p. Dep. NTIS $5.45.

A separate abstract was prepared for each of the seven sections for ERDA Energy Research Abstracts (ERA). In addition, six sections were abstracted for NSA. (RCK)

10961 **CREEP AND FATIGUE IN ELEVATED TEMPERATURE APPLICATIONS. VOLUME II. PROCEEDINGS OF CONFERENCES OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS AND AMERICAN SOCIETY FOR TESTING MATERIALS HELD IN PHILADELPHIA, 23—27 SEPTEMBER 1973, AND IN SHEFFIELD, 1—5 APRIL 1974.** New York; Mechanical Engineering Publications (1975). 109p. (CONF-730916—P2; CONF-7404121—P2).

From International conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973).

Keynote lectures presented at the conference on properties of materials in relation to design and modern codes, and design aspects of elevated temperature technology are included in the volume. Summaries of discussions during the seven sessions of the conference are also presented. (JRD)

10962 **CREEP AND FATIGUE IN ELEVATED TEMPERATURE APPLICATIONS. VOLUME I. PROCEEDINGS OF CONFERENCES OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS AND AMERICAN SOCIETY FOR TESTING MATERIALS HELD IN PHILADELPHIA, 23—27 SEPTEMBER 1973, AND IN SHEFFIELD, 1—5 APRIL 1974.** New York; Mechanical Engineering Publications (1975). vp. (CONF-730916—P1; CONF-7404121—P1).

From International conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973).

Seventy-nine papers were presented at the conference. A separate abstract was prepared for each of twenty-seven papers. Twenty-seven papers are announced in Nuclear Science Abstracts and seven papers are announced in ERDA Research Abstracts. (JRD)

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 10452, 10993

10963 (BNWL-SA—5447) **Preparation and characterization of thick metastable sputter deposits.** Allen, R.P.; Dahlgren, S.D.; Merz, M.D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 9p. (CONF-751172—2). Dep. NTIS $3.50.

From 2. international conference on rapidly quenched metals; Cambridge, Massachusetts, United States of America 'USA' (17 Nov 1975).

High-rate dc supported-discharge sputtering techniques were developed and used to prepare 0.1 mm to 5.0 mm-thick deposits of a variety of metastable materials including amorphous alloys representing more than 15 different rare-earth-transition metal systems and a wide range of compositions and deposition conditions. The ability to prepare thick, homogeneous deposits has made it possible for the first time to investigate the structure, properties, and annealing behavior of these unique sputtered alloys using neutron diffraction, ultrasonic, and other experimental techniques that are difficult or impractical for thin films. More importantly, these characterization studies show that the structure and properties of the massive sputter deposits are independent of thickness and can be reproduced from deposit to deposit. Other advantages and applications of this metastable materials preparation technique include the possibility of varying structure and properties by control of the deposition parameters and the ability to deposit even reactive alloys with a very low impurity content. (auth)

10964 (CEA-CONF—3163) **Isostatic pressing of metal powders.** Cytermann, R.; Auguin, B.; Defresne, A.; Gilles, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Chimie-Physique). 1975. 6p. (In French). INIS.

From 4. European symposium for powder metallurgy; Grenoble, France (13 May 1975).

The process of powders compaction is of great technical importance for the attainment of sintered bodies of high density and strength, or of bodies with controlled porosity. For this purpose, different carbonyl nickel and carbonyl iron powders were isostatically compacted at pressures from 50 to 1300 MN/m² (0.5-13 kbars). The density of compacts was determined by stereology (quantitative microscopic analysis) and weighing. The two methods were found to be in very good agreement and permit to correlate the density of the compact with the applied pressure, while differentiating the stages of compaction (particle rearrangement, local and homogeneous plastic flow) and showing off the influence of material properties (particle size distribution, particle shape, ability of the particles to deform, yield stress required for deformation, etc.). The way from one stage to the other was corroborated by scanning electron microscope observation and x-ray diffraction. Electrical resistance and tensile strength measurements were also carried out and permitted the correlation of these parameters and the applied pressure. (FR)

10965 (CONF-750595—8) **Powder processing for the fabrication of oxide dispersion strengthened ferritic steels.** Coheur, L.; De Wilde, L. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1975. 7p. (In French). INIS.

From 4. European symposium for powder metallurgy; Grenoble, France (13 May 1975).

The addition of Ti to the powder mixtures, which will finally give oxide dispersion strengthened ferritic steels, causes the appearance of large oxide particles in the end product. These particles are detrimental to the tensile properties of 700°C. The method for preparing powder mixtures is recalled. The effect peculiar to each mill has been shown with binary powder mixtures Fe--TiO_2. In this case, the relationship between the end product properties and the mill type has been defined more accurately. (FR)

10966 (SAND—75-8052) **Electropolishing or chemical milling of beryllium to remove machining defects.** Helms, J.R. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 16p. Dep. NTIS $3.50.

The techniques of electropolishing and chemical milling to remove machine damage from beryllium are compared. Both techniques are found to be effective; chemical milling is recommended because it is easier to use and control. (auth)

10967 (UCID—16997) **Methods for surface treating metals, ceramics, and plastics before adhesive bonding.** Althouse, L.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Feb 1976. Contract W-7405-Eng-48. 21p. Dep. NTIS $4.00.

Methods for pretreating the surfaces of metals, ceramics, and plastics before they are coated with adhesive and used in assembly are described. The treatments recommended have been used successfully in the laboratory at LLL. Many are used in the assembly of nuclear devices. However, an unusual alloy or complex configuration may require trials before a specific surface treatment is chosen. (auth)

10968 (Y—2006) **Machinability of HP-9-4-20 high-strength steel.** Morris, T.O. (Oak Ridge Y-12 Plant, Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

Machinability tests were conducted on HP-9-4-20 high-strength steel. This material was found to be easier to machine to close tolerances than the maraging steels when heat treated to a similar yield strength and fracture-toughness level. (auth)

10969 (Y-DA—6611) **Fabrication of integral pipe nipples in 3003 aluminum headers.** Bieber, C.R.; Carson, C. (Oak Ridge Y-12 Plant, Tenn. (USA)). 26 Nov 1975. Contract W-7405-eng-26. 28p. Dep. NTIS $4.00.

In welded aluminium piping systems, certain types of 90-degree "T"-joints can be made at less cost by fabricating pipe nipples directly on the pipes. The feasibility of the pipe nipple fabrication technique was proven by producing more than 1200 each 1-inch diameter, schedule 10 "T"-joints on 3, 4, 6, and 8-inch diameter, schedule 40 aluminum pipe. This concept was expanded by determining the various "T"-joint configurations that could be made by the pipe nipple fabrication technique. Data are presented on forming of 1/2 to 2-inch diameter pipe nipples on 1 to 8-inch diameter 3003 aluminum pipe. Equipment, die geometry, and metal flow characteristics are discussed in detail. Design data are presented for determining which joint configurations can be made by the pipe nipple fabrication technique. (auth)

10970 **Mold with improved core for metal casting operation.** Gritzner, V.B.; Hackett, D.W. (to U.S. Energy Research and Development Administration). US Patent Application 571,445. Filed date 25 Apr 1975. 5p.

The invention is directed to a mold containing an improved core for use in casting hollow, metallic articles. The core is formed of, or covered with, a layer of cellular material which possesses sufficient strength to maintain its structural integrity during casting, but will crush to alleviate the internal stresses that build up if the normal contraction during solidification and cooling is restricted. (auth)

10971 **Fabrication of Nb_x(Al,Ge) superconductors by plasma arc spraying.** Dickinson, J.M.; Giorgi, A.L.; Riley, R.E.; Taub, J.M. (to U.S. Energy Research and Development Administration). US Patent Application 561,561. Filed date 24 Mar 1975. 19p.

A method is described of forming on a tubular metallic substrate, a superconducting coating having a high transition temperature. Powdered, substantially oxygen-free Nb/sub x/(Al, Ge) alloys, where x ranges from 2.5 to 3.3, is plasma arc sprayed on the substrate and annealed in an inert atmosphere. Niobium, titanium, and copper are particularly useful as substrates. (auth)

10972 **Method for treating reactive metals in a vacuum furnace.** Hulsey, W.J. (to U.S. Energy Research and Development Administration). US Patent 3,915,695. 28 Oct 1975. Filed date 8 Jan 1974. 4p.

PAT-APPL-431,819.

The invention is directed to a method for reducing the contamination of reactive metal melts in vacuum furnaces due to the presence of residual gaseous contaminants in the furnace atmosphere. This reduction is achieved by injecting a stream of inert gas directly over the metal confined in a substantially closed crucible with the flow of the gas being sufficient to establish a pressure differential between the interior of the crucible and the furnace atmosphere.

10973 **Method for producing superconducting wire and products of the same.** Marancik, W.G.; Ormand, F.T. (to Airco, Inc.). US Patent 3,918,998. 11 Nov 1975. Filed date 19 Mar 1973. 8p.

A method is described for producing a composite superconducting wire including one or more strands of high-field Type II superconductor embedded in a conductive matrix of normal material. A composite body is prepared which includes a matrix in which are embedded one or more rods of a metal which is capable of forming a high-field Type II superconductor upon high temperature extruded to an intermediate diameter, and then is hot-drawn to a final diameter at temperatures exceeding about 100°C, by multiple passes through drawing dies, the composite being reduced in cross-sectional area approximately 15 to 20 percent per draw. In a preferred mode of practicing the invention, the rods comprise vanadium or niobium, with the matrix being respectively gallium—bronze or tin—bronze, and the superconductive strands being formed by high temperature diffusion of the gallium or tin into the rods subsequent to drawing. (Official Gazette)

10974 **Iridium—hafnium alloy.** Inouye, H.; Liu, C.T. (to U.S. Energy Research and Development Administration). US Patent 3,918,965. 11 Nov 1975. Filed date 26 Apr 1974. 4p.

PAT-APPL-464,429.

A new iridium alloy is described comprised of about 1 weight percent hafnium which greatly improves physical and mechanical properties as compared with pure iridium.

10975 Electroplating a gold-platinum alloy and electrolyte therefor. Wiesner, H.J. (to U.S. Energy Research and Development Administration). US Patent 3,923,612. 2 Dec 1975. Filed date 25 Feb 1974. 4p.

PAT-APPL-445,740.

An electroplating bath for the deposition of gold-platinum alloys is described comprising an aqueous solution of alkali metal hexahydroxyplatinate and alkali metal aurate. Preferably, the solution comprises sufficient alkali metal hexahydroxyplatinate to provide from substantially 15 to substantially 25 grams of platinum per liter and sufficient alkali metal aurate to provide from substantially 0.5 to substantially 3.0 grams of gold per liter. The bath is operated at a temperature preferably in the range of from about 50 to 65°C.

10976 Diffusion bonding of gold to gold. Catalano, E.; Ornellas, D.L. (to U.S. Energy Research and Development Administration). US Patent 3,923,231. 2 Dec 1975. Filed date 11 Apr 1975. 4p.

PAT-APPL-567,230.

Low temperature diffusion bonding of gold to gold is described in which the bond tensile strength exceeds the yield point of gold. The bond is made by wetting the bonding surfaces with mercury and clamping the wetted surfaces together using moderate pressure, at a temperature of 100°C for a period of 22 to 30 days.

10977 Nickel powder and a process for producing it. Pall, D.B. (to U.S. Energy Research and Development Administration). US Patent 3,923,496. 2 Dec 1975. Filed date 26 Apr 1945. 6p.

PAT-APPL-590,427.

A method of producing nickel powder is described, which comprises reacting oxalic acid with aqueous nickel nitrate to produce nickel oxalate, heating the nickel oxalate in an atmosphere of carbon dioxide at a temperature in the range of 450 to 850°C, in the presence of a small amount of a particle grain growth inhibitor to produce a substantially pure nickel powder of uniform particle size and then heating the powder in a mildly oxidizing atmosphere at a temperature of less than 100°C, to render the powder nonpyrophoric.

10978 Precise carbon control of fabricated stainless steel. Nilsen, R.J. (to U.S. Energy Research and Development Administration). US Patent 3,925,109. 9 Dec 1975. Filed date 29 Jan 1974. 6p.

PAT-APPL-438,148.

A process is described for controlling the carbon content of fabricated stainless steel components including the steps of heat treating the component in hydrogen atmospheres of varying dewpoints and carbon potentials.

10979 Nonswelling alloy. Harkness, S.D. (to U.S. Energy Research and Development Administration). US Patent 3,928,027. 23 Dec 1975. Filed date 20 Aug 1974. 4p.

PAT-APPL-499,104.

An aluminum alloy containing one weight percent copper has been found to be resistant to void formation and thus is useful in all nuclear applications which currently use aluminum or other aluminum alloys in reactor positions which are subjected to high neutron doses.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 11067, 11133, 11157

10980 (BNWL-SA—5603) **Solubility and stability of liquid-quenched metastable HCP solid solutions.** Wang, R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 9p. (CONF-751172—1). Dep. NTIS $3.50.

From 2. international conference on rapidly quenched metals; Cambridge, Massachusetts, United States of America "USA" (17 Nov 1975).

This paper shows that simple crystal chemistry rules may be applied to interpret and predict the solubility limit and phase stability of alloys at nonequilibrium conditions. Twenty-nine liquid-quenched metastable hcp solid solutions containing elements with both bcc and hcp allotropic forms were studied. Hcp solid solutions of Group III elements with Ti, Zr, and Hf obtained by splat cooling showed that the metastable solubility limits were semiquantitatively correlated to the size factors and c/a ratios. TEM studies indicated that the extended solubilities results from trapping of extra solute in the α' martensite matrices during L yields beta yields alpha' transformation. Hcp intra-rare earth solid solutions were controlled by the structural metastability, e.g. these hcp phases were all terminated at c/a ratios near 1.597. Thus, the linear correlation of the c/a deviation from ideality and phase stability proposed by Hodges was demonstrated. The solubility limit and structure stability for liquid-quenched metastable hcp phases, as well as the implication for the equilibrium solubility limits, are discussed. (auth)

10981 (IS—2629) **Diffraction evidence for an FCC in equilibrium HCP transformation in ytterbium.** Kayser, F.X. (Ames Lab., Iowa (USA)). Apr 1971. Contract W-7405-eng-82. 36p. Dep. NTIS $5.00.

X-ray powder patterns obtained from polycrystalline wires of high-purity Yb in several heat treated conditions have demonstrated (i) the existence of a martensitic transformation, β-Yb (fcc) reversible α-Yb(hcp) and (ii) that the hexagonal close-packed structure is the thermodynamically stable form of Yb at temperatures below approximately 270°K. Precision lattice parameters determined for both polymorphs at room temperature indicate the fractional volume change on the transformation to be 0.0091, a magnitude that is consistent with the belief that α-Yb is divalent. This can be regarded as a stacking fault transformation, and one wherein the preponderance of the volume change is accommodated by displacements normal to the habit plane. (auth)

10982 (ORO—4044-6) **Technical progress report on studies on microstructure-property relationships in austenitic stainless steels, January 1, 1975—December 31, 1975.** Spruiell, J.E. (Tennessee Univ., Knoxville (USA)). 1976. Contract AT(40-1)-4044. 36p. Dep. NTIS $4.00.

Research progress is reported in programs on microstructural stability of stainless steels. Results of studies are summarized on time-temperature-precipitation in 316 and 321 stainless steels, phase formation in austenitic stainless steels, corrosion behavior of austenitic stainless steels and weld metals, and cold work and recovery in austenitic stainless steels. (JRD)

10983 (UCRL—51902) **Phase diagrams of the elements.** Young, D.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Sep 1975. Contract W-7405-eng-48. 68p. Dep. NTIS $5.45.

A summary of the pressure-temperature phase diagrams of the elements is presented, with graphs of the experimentally determined solid-solid phase boundaries and melting curves. Comments, including theoretical discussion, are provided for each diagram. The crystal structure of each solid phase is identified and discussed. This work is aimed at encouraging further experimental and theoretical research on phase transitions in the elements. (auth)

10984 (ORNL-tr—4089) **Phase composition of nitrided ferrochromium.** Alybina, A.N.; Tudorovskaya, M.M.; Rabinovich, A.V.; Sulaev, I.E.; Yaroshenko, V.V.; Krivusha, L.V. Translated by M. Gerrard from *Metall. Koksokhim.*; **39**: 30-34(1974). 6p. Dep. NTIS $3.50.

The phase composition of nitrided ferrochromium and the chemical composition of individual phases in this alloy were studied as a function of production method and nitrogen content. It was found that acid separation can be used to determine the amount of N bound in different nitrides and the alcohol-halogen method for lower nitrides in the matrix. The recommended optimum upper limit of nitrogen in the alloy is 7.5 to 8 percent. (JRD)

10985 Calculation of the electronic structure and related physical properties of platinum. Fradin, F.Y. (Argonne National Lab., IL); Koelling, D.D.; Freeman, A.J.; Watson-Yang, T.J. *Phys. Rev., B;* **12**: No. 12, 5570-5574(15 Dec 1975).

The electronic band structure, density of states, and Fermi surface of Pt metal have been calculated using the relativistic-augmented-plane-wave method. The Fourier series representation of the a priori band structure has been found to yield a Fermi surface in good agreement with the de Haas-van Alphen results. The subband densities of states of platinum have been calculated with 0.25-mRy resolution using a tetrahedron scheme. The temperature dependences of the spin susceptibility, the electrical resistivity, the nuclear spin-lattice relaxation rate, and the electronic-specific-heat coefficient have been calculated in the constant-matrix-element approximation and have been found to be in reasonable agreement with the experimental results. (auth)

10986 Cubic and hexagonal single-crystal elastic constants of a cobalt—nickel alloy. Weston, W.F.; Granato, A.V. (Univ. of Illinois, Urbana). *Phys. Rev., B;* **12**: No. 12, 5355-5362(15 Dec 1975).

A cubic single crystal of cobalt—32 wt. percent nickel was transformed to a hexagonal single crystal by cooling a uniaxially prestressed specimen. Evidence that the transformed specimen is a hexagonal single crystal was obtained by Laue x-ray photographs, surface markings, analysis of the magnitude of sound-wave velocities and the symmetry of their polarizations, and the magnetic field

dependence of the attenuation of certain modes. The complete sets of second-order and third-order elastic constants of both the cubic and hexagonal phases were measured. These constants were used to calculate the change in enthalpy upon transformation, and the stacking-fault energy. The results are in good agreement with available thermodynamic data. (auth)

10987 Mean-square displacements of (100) surface atoms in vanadium determined by low-energy electron diffraction. Cheng, D.J. (Univ. of California, Irvine); Wallis, R.F.; Megerle, C.; Somorjai, G.A. *Phys. Rev., B;* **12**: No. 12, 5599-5607(15 Dec 1975).

The effective-surface Debye temperature for the (100) face of single-crystal vanadium has been measured as a function of incident electron energy in the energy range 0 to 400 eV using low-energy-electron diffraction. The ratio of surface-to-bulk atomic mean-square displacements has been estimated from the experimental data and has been investigated theoretically. A lattice-dynamical model consisting of central-potential interactions up to fourth neighbors together with harmonic angle-bending interactions is employed. The calculations have been performed using a set of special wave-vector points in the two-dimensional Brillouin zone which are the most efficient in finding the average of a periodic function over the Brillouin zone. Results have been obtained for both unchanged and changed force constants for the surface atoms. A comparison between the experimental and theoretical results is included. (auth)

10988 Phase boundaries and thermodynamic analysis of the rare-earth-rich alloys in the La—Tl and Pr—In systems. McMasters, O.D.; Gschneidner, K.A. Jr. (Ames Lab., IA). *J. Less-Common Met.;* **44**: 281-289(Jan 1976).

The phase boundaries in the rare-earth-rich portions of the lanthanum—thallium and praseodymium—indium systems were determined using differential thermal methods. The solid solubility of Tl in bcc γ-La is 11.0 at. percent at the 655°C eutectic temperature and that in fcc β-La is 1.9 at. percent at the 640°C eutectoid temperature. The solid solubility of In in bcc β-Pr is 9.8 at. percent at the 825°C eutectic temperature while that in dhcp α-Pr is 5.6 at. percent at the 725°C eutectoid temperature. The first La-rich compound, La_3Tl, decomposes peritectoidally at 645°C and La_4Tl melts peritectically at 900°C. The compound Pr_3In decomposes peritectically at 930°C. The thermodynamic analyses data for these alloys were compared with those reported for the La—In and Pr—Tl systems. (auth)

10989 First-order transitions, symmetry, and the ϵ expansion. Bak, P.; Krinsky, S.; Mukamel, D. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev. Lett.;* **36**: No. 1, 52-55(5 Jan 1976).

The first-order nature of the antiferromagnetic transitions in Cr, Eu, UO_2, and MnO can be explained by noting that the corresponding Landau-Ginzburg-Wilson Hamiltonians possess no stable fixed points in 4-ϵ dimensions.

10990 Precipitation of In_2Bi from supersaturated indium. Otto, G.H. (Univ. of Alabama, Huntsville). *Scr. Metall.;* **10**: No. 2, 139-142(Feb 1976).

The isothermal decomposition of supersaturated α-phase and its subsequent adjustment to compositional equilibrium in In—Bi alloys were investigated by resistivity measurements. Results show that the equilibrium state determined electrically is identical with the thermodynamic equilibrium in these alloys. (JRD)

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 10499, 10540, 10563, 10564, 10676, 10704

10991 (CEA-CONF—3119) **Determining the mechanical properties of high porosity nickel.** Frappier, J.C.; Poirier, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). 1975. 6p. (In French). INIS.

From 4. European symposium for powder metallurgy; Grenoble, France (13 May 1975).

The following tests were carried out on high porosity (40 to 70 percent) sintered nickel: tensile tests, compression tests, and diametral crushing tests using strain gauges and extensometers. Results were obtained on the relationship of elastic properties to porosity, Poisson coefficient in relation to deformation, variations of yield strength, and breaking stress. These various properties were also studied in relation to the sintering methods and the properties of the powders used. (FR)

10992 (LA—6064-MS) **Ductile to brittle transition of U—0.75 wt% Ti penetrator cores.** Jones, T.I.; Sandstrom, D.J. (Los Alamos Scientific Lab., N.Mex. (USA)). Aug 1975. Contract W-7405-Eng-36. 10p. Dep. NTIS $4.00.

V-notch Charpy impact specimens were machined from U—0.75 wt percent Ti penetrator cores supplied by the Air Force Armament Laboratory. The response of these specimens to impact loads at various temperatures was measured. The data indicated that the impact energy required to cause fracture was a function of temperature and appeared to be insensitive to microstructural and hardness variations. All tests from —54 to 300°C indicated a brittle condition with data fitting the impact energy = 4.41e$^{0.004t}$/sup t/ equation. (auth)

10993 (ORNL-TM—5074) **Fabrication and mechanical test data for the four 6-inch-thick intermediate test vessels made from steel plate for the Heavy Section Steel Program.** Childress, C.E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 28p. Dep. NTIS $4.00.

The HSST Program has among its goals the objective of demonstrating the capability to predict safe behavior of thick-walled pressure vessels containing flaws of known dimensions under frangible, transitional, and tough loading regimes. To accomplish these objectives the program is conducting a series of tests involving 6-in.-thick pressure vessels which will serve as test specimens for assisting in the characterization of failure under these loading conditions. Among the vessels a number of parameters, such as weld type, weld location, flaw size and shape, and test temperature and pressure, will be selectively varied to show that a rationale exists for dealing with the varied stress and metallurgical states which normally exist in commercial nuclear reactor vessels. Each vessel will serve as a go, no-go determination of critical flaw size for a specific set of test parameters. Item 4 of the previous issues in this series covers the fabrication details of the first six 6-in.-thick test vessels, which were fabricated from ASTM A-508 Cl 2 forging materials. This report covers the fabrication details of four additional 6-in.-thick intermediate test vessels having shell courses fabricated from ASTM A-533 Gr B Cl 1 plate. The remaining components were made from forgings. Essentially this report is a continuation of ORNL-TM-4351; it describes the manufacturing details of the individual parts and their ultimate assembly into finished vessels. Details concerning chemical composition and mechanical and nondestructive test data are presented. (auth)

10994 (SAND—75-0311) **Temperature dependence of the elastic moduli of Kovar and OFHC copper above room temperature.** Gieske, J.H. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)789. 25p. Dep. NTIS $4.50.

Experimental results of the ultrasonic longitudinal and shear velocities in 3/4-in. diameter rods of Kovar and OFHC copper are presented for elevated temperatures. An ultrasonic pulse echo technique was used in conjunction with rods of about 12 in. in length. The thermal variation of Young's modulus, shear modulus and Poisson's ratio were calculated from the ultrasonic data. A 6 percent increase in modulus versus temperature was observed for Kovar up to about 450°C from which point a steady decrease in modulus versus temperature followed. OFHC copper showed a steady decrease in modulus versus temperature, and it also exhibited permanent room temperature material property changes as a result of annealing the material. (auth)

10995 Fatigue-crack propagation behavior of incoloy 800 at elevated temperatures. James, L.A. (Westinghouse Hanford Co., Richland, WA). *J. Eng. Mater. Technol.;* **96**: No. 4, 249-254(Oct 1974).

Linear-elastic fracture mechanics techniques were used to characterize the fatigue-crack propagation behavior of Incoloy 800 in an air environment over the temperature range 75 to 1200°F. Crack growth rates were measured over the range 5×10^{-7} to 5×10^{-5} in./cycle. Material Grades 1 and 2 were found to exhibit essentially the same behavior over this range. In general, crack growth rates increased with increasing test temperature, although the increases were less than previously noted for austenitic stainless steels. This difference is probably related to the superior oxidation resistance of Incoloy 800. (auth)

10996 Cracking of Ti—6Al—4V alloys under sustained load in ambient air. Yoder, G.R.; Griffis, C.A.; Crooker, T.W. (Naval Research Lab., Washington, DC). *J. Eng. Mater. Technol.;* **96**: No. 4, 268-274(Oct 1974).

Results of a study reveal that degradation in load-carrying capacity owing to sustained-load cracking (SLC) can occur in alloys of the Ti—6Al—4V family. Each of eight alloys tested with fatigue-precracked specimens in ambient room air exhibited the phenomenon, with degradations ranging from 11 to 35 percent. The degree of susceptibility to SLC was seen to be dependent upon crack orientation in rolled plate materials. The threshold stress-intensity factor below which SLC failures will not occur in these alloys, K/sub It/, appears to represent a more conservative fracture-safe design parameter than the plane-strain fracture toughness K/sub Ic/, which cannot account for time-delayed failures owing to SLC. (auth)

10997 Interpretation of the Yoder—Griffis—Crooker observations of sustained-load cracking in Ti-6Al-4V. Krafft, J.M. (Naval Research Lab., Washington, DC). *J. Eng. Mater. Technol.*; **96**: No. 4, 275-282(Oct 1974).

Their recent NRL report documents a substantial degradation in load carrying capability of partially cracked specimens of annealed Ti—6Al—4V plate in a room air environment. The effect is analyzed as a special case of tensile ligament instability model, set up to permit integration of crack growth rate over the path to K/sub Ic/. Results show that the time dependence and magnitude of the load carrying capability and of the sustained load crack growth SLC are predictable from plastic flow characteristics, including the transient stress relaxation rate, and from a slight environmental effect. A simplified diagram for engineering assessment of SLC is presented. Importance is attached to the persistence of stress relaxation, as much as to its rate, in inducing SLC. Little effect is expected from the level of fracture toughness to the extent that it is controlled by the process zone size d/sub T/. (auth)

10998 Development of elevated temperature fatigue design information for Type 316 stainless steel. Jaske, C.E.; Mindlin, H.; Perrin, J.S. (Battelle Columbus Labs., OH). pp 163.1-163.7 of In Creep and fatigue in elevated temperature applications. Volume I. New York; Mechanical Engineering Publications (1975).

From International conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973).

See CONF-730916—P1.

To develop material properties information for use in elevated-temperature fatigue design, an extensive study of the fatigue and stress-strain behavior of Type 316 stainless steel was conducted at temperatures from 21 to 649°C. Fatigue life and cyclic stress-strain curves were developed. Creep-fatigue interaction was evaluated by conducting strain hold-time tests at 566 and 649°C. Hold periods at peak tensile strain produced a large reduction in cyclic life. It was found that both a linear damage rule and the strain-partitioning method could be used to assess cumulative creep and fatigue damage. Aging for 1000 h at test temperature before testing caused only small or no changes in continuous cycling fatigue resistance at 566 and 649°C and in tension hold-time fatigue resistance at 566°C. This aging produced a significant increase in tension hold-time fatigue resistance at 649°C. (auth)

10999 Low-cycle fatigue results for spot-welded AISI 316 stainless steel strip at elevated temperatures. Flagella, P.N.; Hundal, R. (Westinghouse Electric Corp., Madison, PA). pp 167.1-167.10 of In Creep and fatigue in elevated temperature applications. Volume I. New York; Mechanical Engineering Publications (1975).

From International conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973).

See CONF-730916—P1.

Results are reported for load-controlled, low-cycle fatigue experiments conducted on spot-welded AISI 316 stainless steel strip (0.25 mm thick) at room temperature, 538, 621, and 704°C in air. A detailed study evaluating the effects of hold time in tension at 621°C was also performed. Three distinct frequency regions, related to cycle dependent (fatigue) and time dependent (creep) failures, were identified. The high frequency region (1 to 200 cycles/ min) cycles to failure was essentially independent of frequency and hold time. The intermediate frequency region involved fatigue-enhanced creep and is described by a power law expression. The low frequency region is described by the creep-rupture life. Metallographic observations identify different fracture modes consistent with cycle dependent and time dependent regions. (auth)

11000 Towards the standardization of time—temperature parameter usage in elevated temperature data analysis. Goldhoff, R.M. pp 174.1-174.8 of In Creep and fatigue in elevated temperature applications. Volume I. New York; Mechanical Engineering Publications (1975).

From International conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973).

See CONF-730916—P1.

Work devoted to establishment of recommended practices for correlating and extrapolating relevant data on creep-rupture properties of materials at high temperatures is described. An analysis of the time-temperature parameter is included along with descriptions of analysis and evaluation methods. Results of application of the methods are compared. (JRD)

11001 Creep properties of a Type 308 stainless steel pressure vessel weld with controlled residual elements. King, R.T.; Stiegler, J.O.; Goodwin, G.M. (Oak Rige National Lab., TN). pp 181.1-181.7 of In Creep and fatigue in elevated temperature applications. Volume I. New York; Mechanical Engineering Publications (1975).

From International conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973).

See CONF-730916—P1.

A SMA Type 308 stainless steel pressure vessel test weld with the CRE (controlled residual elements) boron (0.007 percent), titanium (0.06 percent), and phosphorus (0.04 percent) has been tested in creep between 482 and 650°C. Improved ductility compared with that of standard welds in tests lasting several thousands of hours is observed. Systematic variations of creep properties through the weld are due to thermal and mechanical cycling during the welding process. Anisotropic deformation related to local substructure and preferred crystallographic orientation occurs. Creep strengths are acceptable by present design rules. (auth)

11002 Non-linear creep fatigue analysis of a sodium heat exchanger component for the fast flux test facility. Gangadharan, A.C.; Pai, D.H.; Berman, I. (Foster Wheeler Corp., Livingston, NJ). pp 215.1-215.8 of In Creep and fatigue in elevated temperature applications. Volume I. New York; Mechanical Engineering Publications (1975).

From International conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973).

See CONF-730916—P1.

An analysis is presented of a metallic component subjected to pressure loads and severe thermal transients operating in the range in which creep is significant. The analysis is applied to 304 stainless steel heat exchangers for FFTF. Information is included on analysis methods, design requirements, and use of finite element program MARC-II. (JRD)

11003 Comparison of the strain-controlled low cycle fatigue behavior of stainless Type 304/308 weld and base material. Brinkman, C.R.; Koth, G.E.; Beeston, J.M. (Aerojet Nuclear Co., Idaho Falls, ID). pp 218.1-218.11 of In Creep and fatigue in elevated temperature applications. Volume I. New York; Mechanical Engineering Publications (1975).

From International conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973).

See CONF-730916—P1.

Results are reported from strain-controlled fatigue tests conducted on uniform gage specimens taken from several different positions and orientations with double-U groove heavy section stainless Type 304/308 weldments. Room temperature and 593°C test results are reported from strain-controlled fatigue, cyclic stress-strain, and elastic anisotropy measurement tests. The fatigue resistance of the weldment material was found to be inferior to that of base material at room temperature; however, the degree to which it was inferior was specimen orientation dependent. At 593°C specimens taken from a parallel orientation with respect to the weld seam exhibited a fatigue resistance that was nearly equivalent to that of the base material. Transverse and transverse fusion line material showed inferior resistance to base material at both room temperature and 593°C, however, comparison was difficult due to strain concentrations that occurred in the transverse weldment material. Extensive variations in apparent elastic properties, i.e., Young's modulus and Poisson's ratio were found to occur in weldment material at both room temperature and 593°C. (auth)

11004 Design methods for structures under thermal ratchet. Branca, T.R.; McLean, J.L. (Teledyne Materials Research, Waltham, MA). pp 228.1-228.7 of In Creep and fatigue in elevated temperature applications. Volume I. New York; Mechanical Engineering Publications (1975).

From International conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973).

See CONF-730916—P1.

Previous work on the thermal ratchet analysis of a simple pipe is extended to the case of an intersection of a pipe with a spherical shell. The chosen nozzle configuration is subjected to an internal pressure which remains constant, and a cyclic thermal transient which is representative of the type of transient that might be expected for components of a LMFBR. A number of cross-sections through the nozzle were examined, each yielding a different combination of elastic primary and secondary stress. These stresses, together with their associated cyclic strain growth, as determined from an elastic-plastic-creep analysis of the nozzle, were then plotted on a Miller or Bree-type diagram. Thus, a number of points, one for each cross-section considered, were available for comparison with the data obtained from the ratchet

analysis of simple pipe sections. Both the elastic and inelastic analyses on the nozzle were performed using the finite element method of structural analysis of the ANSYS computer code. The pipe ratchetting cases were computed using the Oak Ridge National Laboratory PLACRE code. For a sample pipe ratchet case, a brief comparison is given between the version of ANSYS used in this study, the ANSYS version used in the previous work and the PLACRE code. The three programs did not yield identical results. Further study is needed to resolve the discrepancies that were observed. The results of the comparison between the nozzle ratchet and pipe ratchet solutions indicate that reasonable predictions can be made for the nozzle ratchet strains based on elastic parameters and design curves developed from pipe ratchetting solutions. (auth)

11005 Quasistatic deformation of porous beryllium and aluminum. Schock, R.N.; Abey, A.E.; Duba, A. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *J. Appl. Phys.*; 47: No. 1, 53-63(Jan 1976).

Loading and unloading of two types of porous beryllium and a porous aluminum under conditions of uniaxial strain, proportional loading, and hydrostatic pressure indicate that yielding is dominated by porosity. Analysis of the data prior to yielding indicates that aspherical pores cause increased compressibility on initial loading. All materials exhibit enhanced compaction when loaded under nonhydrostatic stress conditions. Models which treat the collapse of spherical pores do not agree with the beryllium data, probably because of the influence of aspherical pores and pore-size distribution. (AIP)

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 10268, 10389, 10564, 10639, 10756, 11084, 11233, 12210, 12213, 12281, 12282, 12287, 12288, 12289, 12290, 12295

11006 (ANCR—1292) **Review of the physical metallurgy of Alloy 718.** Keiser, D.D.; Brown, H.L. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1976. Contract E(10-1)-1375. 27p. Dep. NTIS $4.00.

The physical metallurgy of Alloy 718 is updated to 1976 on the basis of a survey of post-1967 literature and current experimental data. Composition, microstructures, and mechanical properties are correlated with heat treatment parameters. The current state of understanding of phase stability, strengthening mechanisms, deformation modes, recovery, and recrystallization in this material is described.

11007 (BNWL-SA—5445) **Metastable A-15 phase superconductors transformed from metastable BCC Nb_3 X solid solutions made by high-rate sputter deposition.** Wang, R.; Dahlgren, S.D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 8p. (CONF-751172—3). Dep. NTIS $3.50.

From 2. international conference on rapidly quenched metals; Cambridge, Massachusetts, United States of America [USA] (17 Nov 1975).

In the course of synthesis of superconductive alloys up to 1 mm thick by high-rate sputter deposition, metastable bcc phases of Nb_3Al, Nb_3Sn, Nb_3Ge, $Nb_3(AlGe)$, and Nb_3Si were obtained. This paper reports our study of the phase transformation of metastable bcc solid solutions by heat treatment. The grain sizes of the as-deposited bcc phases depended on deposition temperature. For depositions made at approximately 10°C, large variations of grain size were observed among the materials, e.g. approximately 1000 A for Nb_3Al and Nb_3Sn, approximately 50 A for Nb_3Ge, $Nb_3(AlGe)$, and Nb_3Si. All bcc phases transformed to the A-15 phase at approximately 650°C within 24 hours except for Nb_3Si, which transformed into a tetragonal phase at approximately 750°C. The grain size of the A-15 phase was approximately three to five times the initial grain size of the bcc phase. The phase transformations in $Nb_3(AlGe)$ and Nb_3Si were described by tentative time-temperature-transformation diagrams. Transmission electron microscopic investigation of the bcc yields A-15 transformation for Nb_3Al shows the presence of both coherent and incoherent type precipitates in the early stages of transformation. (auth)

11008 (CALT—822-80) **Trend of superconductivity in amorphous superconducting transition metals and their alloys.** Poon, S.J. (California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Engineering Materials). Dec 1975. Contract AT(04-3)-822. 21p. Dep. NTIS $3.50.

A plausible interpretation for the trend of superconducting transition temperature T/sub c/ in amorphous transition metal TM alloys is presented from a chemical point of view. It is shown that the T/sub c/ behavior is not a reflection of the dependence of the atomic parameter eta on the number of electrons per atom, but rather due to two other effects. One is the changes in the density of states due to the mixing of antibonding and bonding states in the bcc amorphous metals. The other is an increase in the number of valence d electrons participating in the phonon-induced d-d coupling towards the mid series. (auth)

11009 (CONF-760209—11) **Stress distribution in helium-ion implantations.** Hall, B.O. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 19p. Dep. NTIS $3.50.

From 2. international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America [USA] (16 Feb 1976).

The stress introduced into a material in a monoenergetic helium-ion implantation is calculated for an ion beam with a gaussian intensity distribution. An effective beam spot of the order of several millimeters was chosen as typical of blistering experiments. The sample is assumed to be semi-infinite and isotropic. The ion distribution is cylindrically symmetric with a gaussian depth profile. The parameters defining the distribution are consistent with incident ion energies of approximately 40 and approximately 400 keV in both nickel and niobium. The volume expansion caused by the implanted ions is assumed to be proportional to the local helium concentration; the validity of this assumption is discussed. The maximum shear stress is calculated as a function of depth, and the volume expansion per helium atom required to produce plastic deformation at the experimentally observed critical doses in niobium is found to be of the order of one atomic volume.

11010 (COO—2296-10) **Diffusional creep of multicomponent systems. Progress report, February 1, 1975—January 31, 1976.** Li, J.C.M. (Rochester Univ., N.Y. (USA). Dept. of Mechanical and Aerospace Sciences). 1976. Contract E(11-1)-2296. 45p. Dep. NTIS $4.00.

Hydrogen embrittlement was studied from the viewpoint of the interaction of hydrogen with the stress field of particles. The interaction between dislocation loops was studied to include shear components of the Burgers vector. It turned out that this additional component could stabilize both the cuboidal arrangement and the stair-step configuration of square dislocation loops. These results were used to explain certain precipitation morphologies. Equipment improvements are reported. The only creep results obtained so far were the temperature and stress dependences of penetration velocity on a beta-tin single crystal, and the stress dependences of lead and succinonitrile polycrystals. They agree with literature data. (DLC)

11011 (COO—2314-9) **Experimental determination of the temperature dependence of metallic work functions at low temperatures. Progress report, March 1, 1975—February 9, 1976.** Pipes, P.B. (Dartmouth Coll., Hanover, N.H. (USA). Dept. of Physics and Astronomy). 1976. Contract E(11-1)-2314. 10p. Dep. NTIS $3.50.

Progress described includes measurements of the temprature dependence of the work functions for niobium and aluminum between 2 and 20°K and the development of a simple theoretical model to explain the effects of adsorbed ^4He gas on the temperature dependence of the work function in niobium. (auth)

11012 (LA—6069-MS) **High-density metals and metallic composites for improved fragmentation submunitions.** Craig, B.G.; Honnell, R.E.; Lederman, G.F. Jr.; Sandstrom, D.J. (Los Alamos Scientific Lab., N.Mex. (USA)). Aug 1975. Contract W-7405-Eng-36. 26p. Dep. NTIS $5.00.

The fragmentation of cases (50.8-mm-id) made of tungsten, a tungsten alloy, and depleted uranium (D-38) can be controlled, and velocities greater than 1 mm/μs can be achieved for lethal size fragment weights. Fragmentation was controlled by internal grooves, by internal screens, and by a spheroid-in-weak-matrix scheme. A thin polymer liner was used inside of a grooved tungsten case in one experiment; this system performed exceptionally well. The ease of fabricating cases with D-38 or with the tungsten-alloy spheroid-in-matrix scheme offers an attractive advantage over tungsten and tungsten alloy.

11013 (LBL—4148) **Thermodynamic and kinetic studies of some Group III and Group V elements and alloys by solid state electrochemical techniques.** Anderson, T.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-Eng-48. 182p. Dep. NTIS $7.50.

Thesis.

The Gibbs free energy of forming gallium sesquioxide and indium sesquioxide are measured using a CO_2—CO—O_2 gas reference electrode and calcia stabilized zirconia as the solid electrolyte. The free energies are: ΔG°/sub f/(β-Ga_2O_3(c)) equals -(265,309 +- 152) + (82.47 +- 0.16) (T/K) cal mol^{-1} and ΔG°/sub f/(In_2O_3 (c)) equals -(223,160 +- 137) + (79.47 +- 0.12) (T/K)

cal mol⁻¹. A solid state galvanic cell is employed to measure gallium activities in Ga—Sb liquid alloys. Results show moderate negative deviations from ideality in the composition range 0.039 less than x/sub Ga/ less than 0.833. Partial molar enthalpies and entropies are calculated, and agree wih calorimetric data. Results are combined with calorimetric data to calculate the liquidus temperatures of the Ga—Sb system, which are in excellent agreement with measurements. Effect of short-range ordering is also investigated. Coulometric titration techniques are used to investigate the solubility and diffusivity of oxygen in liquid indium. Dissolved atomic oxygen is found to follow Henry's law and a saturation solubility of x_o/sup sat/ equals 3.3 x 10^{-3} is determined at 908°K. From a galvanostatic response of an indium electrode, an oxygen diffusivity of 2.2 x 10^{-6} cm^2 s^{-1} is found, in good agreement with other available data. (LK)

11014 (ORNL—5078, pp 51-139) **Materials development.** McCoy, H.E. Feb 1976.

In Molten-salt reactor program. Semiannual progress report for period ending August 31, 1975.

The main thrust of the materials program is the development of a structural material for the MSBR primary circuit which has adequate resistance to embrittlement by neutron irradiation and to shallow intergranular attack by fission product penetration. A modified Hastelloy N containing 2 percent Ti has good resistance to irradiation embrittlement; however, it remains to be shown that the alloy has sufficient resistance to shallow intergranular cracking. Numerous laboratory tests are in progress to answer this important question. Laboratory programs to study Hastelloy N—salt—tellurium interactions are being established, including the development of methods for exposing test materials under simulated reactor operating conditions. The procurement of products from two commercial heats (8000 and 10,000 lb) of 2 percent Ti—modified Hastelloy N continued. All products except seamless tubing were received, and much experience was gained in the fabrication of the new alloy. The work on chemical processing materials is concentrated on graphite. Capsule tests are in progress to study possible chemical interactions between graphite and bismuth-lithium solutions and to evaluate the mechanical intrusion of these solutions into the graphite. (JRD)

11015 (UCR—34P77-47) **Electric and magnetic properties of transition metals and their compounds.** (Energy Research and Development Administration, Washington, D.C. (USA)). 1 Feb 1976. Contract AT(04-3)-34. 44p. Dep. NTIS $4.00.

Results of studies on the electric and magnetic properties of transition metals and their compounds are presented in sections on rare earth metals, rare earth compounds, and transport properties of IrO_2, RuO_2, and related materials. (JRD)

11016 (UCRL—50028-75-2, pp 1-15) **Theoretical EOS group.** 1975.

In H-Division quarterly report, April—June 1975.

Efforts devoted to the development of theoretical techniques for the description of materials properties under extreme conditions are summarized along with work on the construction of equation of state (EOS) tables for specific materials. Results of research are reported on EOS of high Z materials, EOS of atomic iodine, computer methods for EOS data, EOS of solid metallic H, universal form for fluids governed by power inverse power potentials, and EOS for Cs shock compression experiment analysis. (JRD)

11017 (UCRL—50028-75-2, pp 22-28) **Experimental EOS group.** 1975.

In H-Division quarterly report, April—June 1975.

Research on the properties of materials at high pressures and temperatures is reported. Results of experiments are presented on equation of state (EOS) of sapphire, quartz, polycarbonate and granite. Results of isobaric expansion experiments on U and W at 6000°K are also presented. (JRD)

11018 (UCRL—50028-75-2, pp 29-38) **Dynamic materials response group.** 1975.

In H-Division quarterly report, April—June 1975.

Results of research on the response of materials to a wide range of pressure, time, and temperature are reported. Results of studies are summarized on tamped impulses, time-resolved impulse gages for underground testing, armor design for defense against long rod penetrators, advanced armor design, and properties of porous materials. (JRD)

11019 **Anisotropy of H/sub c2/ and its implications to grain-boundary flux pinning in V_3Si.** Kramer, E.J.; Knapp, G.S. (Argonne National Lab., IL). *J. Appl. Phys.*; **46**: No. 10, 4595-4596(Oct 1975).

The anisotropy of H/sub c2/ was measured in a V_3Si monocrystal and was found to be much larger than in other materials. The max elementary pinning force f/sub p/ is estimated to be approximately 0.01 dyn/cm at the reduced field H/H/sub c/ = 0.25 and 4.2°K. Control of texture as well as of grain size is important for improving J/sub c/ in A-15 compounds. (DLC)

11020 **Magnetic properties of RMn_2Ge_2 compounds (R = La, Ce, Pr, Nd, Cd, Tb, Dy, Ho, Er, and Th).** Narasimhan, K.S.V.L.; Rao, V.U.S.; Bergner, R.L.; Wallace, W.E. (Univ. of Pittsburgh). *J. Appl. Phys.*; **46**: No. 11, 4957-4960(Nov 1975).

The magnetic properties were investigated from 4.2 to 500°K. $LaMn_2Ge_2$, $CeMn_2Ge_2$, $PrMn_2Ge_2$, and $NdMn_2Ge_2$ are ferromagnetic with Curie temperatures of 306, 316, 334, and 334°K, respectively. The heavy rare-earth compounds do not order ferromagnetically until low temperatures. $GdMn_2Ge_2$ shows a sharp magnetic transition at 97°K both in the magnetization-vs-temperature and resistivity-vs-temperature data. For this compound, it is proposed that above 97°K the Mn moments order antiferromagnetically among themselves while the Gd moments are disordered. Below 97°K, the Mn moments couple ferromagnetically with each other but are opposed to the ordered Gd sublattice. Magnetic moment obtained at 4.2°K can be explained for all the compounds on the basis of an antiferromagnetic coupling between Mn and rare-earth spins. (auth)

11021 **Self-heating effects in thin-film type-I superconductors.** Huebener, R.P. (Argonne National Lab., IL). *J. Appl. Phys.*; **46**: No. 11, 4982-4985(Nov 1975).

Current-induced electrical resistance was investigated for zero applied magnetic field in long superconducting strips of tin 100 to 200 μm wide and up to a few μm thick. Self-heating effects were observed similar to those reported recently by Skocpol, Beasley, and Tinkham (SBT) for "one-dimensional" tin microbridges with dimensions much smaller than those of our samples. Results agree well with the one-dimensional SBT hotspot model for long microbridges. In the presence of an inductive load, relaxation oscillations can be observed resulting from the negative differential resistance region in the V-I characteristic. (auth)

11022 **Nickel-base alloys having a low coefficient of thermal expansion.** Baldwin, J.F.; Maxwell, D.H. (to Sorcery Metals, Inc.). US Patent 3,918,964. 11 Nov 1975. Filed date 21 Dec 1973. 12p.

Alloy compositions consisting predominantly of nickel, chromium, molybdenum, carbon, and boron are disclosed. The alloys possess a duplex structure consisting of a nickel—chromium—molybdenum matrix and a semi-continuous network of refractory carbides and borides. A combination of desirable properties is provided by these alloys, including elevated temperature strength, resistance to oxidation and hot corrosion, and a very low coefficient of thermal expansion. (auth)

11023 **Optical absorption in Al and dilute alloys of Mg and Li in Al at 4.2 K.** Benbow, R.L.; Lynch, D.W. (Ames Lab., IA). *Phys. Rev., B;* **12**: No. 12, 5615-5621(15 Dec 1975).

The absorptances of Al and alloys of up to 5.5 at. percent of Li and Mg in Al were measured at 4.2°K in the 0.2 to 3.0-eV range. The theory of Ashcroft and Sturm was fitted to the data. The fit obtained is reasonably good, provided three relaxation times are used, one for the Drude term and one for each type of transition between parallel bands. The fit is slightly better for the more concentrated alloys. In all cases the discrepancy between the fit and the data is greatest in the region between the two interband peaks in the optical conductivity, and known extensions to the theory do not qualitatively improve the fit. Pesudopotential Fourier coefficients U_{200} and U_{111} obtained from the fits vary with solute type and concentration. The variation can be explained semiquantitatively with a virtual-crystal pseudopotential. (auth)

11024 **Influence of unoccupied 5f-band states on the Fermi surface of Th metal.** Koelling, D.D.; Freeman, A.J. (Argonne National Lab., IL). *Phys. Rev., B;* **12**: No. 12, 5622-5626(15 Dec 1975).

The influence of unoccupied 5f-band states on the Fermi surface of Th metal is determined by means of highly precise calculations of the Fermi-surface areas and effective masses. Comparison with experiment shows excellent agreement when the 5f electrons are treated as itinerant, unlike the predictions of the localized (f states removed) model. This result adds strong evidence for the itinerant nature of the occupied 5f states in the light actinides. (auth)

11025 **Obtaining densities of states from tunneling between two superconductors.** Vopat, F.E.; Lee, H.J.; Tomasch, W.J. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). *J. Appl. Phys.*; **47**: No. 1, 329-332(Jan 1976).

Tunneling between two superconductors, S/subA/ and S/subB/, is considered in the approximation that S/subA/ is a BCS

superconductor and that thermal excitations are unimportant. Inversion formulas are developed which permit numerical evaluation of the tunneling density of states for S/subB/ when the ac conductance, or its voltage derivative, is known as a function of bias voltage. The method is applied to finely spaced (~30 μV) conductance structure produced by quasiparticle interference phenomena in a thick (~30 μm) In film at 0.3 K (so-called Tomasch effect). (AIP)

11026 Superconductivity in the technetium—titanium alloy system. Koch, C.C. (Oak Ridge National Lab., TN). *J. Less-Common Met.*; **44**: 177-181(Jan 1976).

A survey of superconducting transition temperatures and crystal structures has been made for the Tc—Ti alloy system. The highest transition temperature in this system (10.89°K) occurs in the hcp technetium-rich solid solution. The Tc—Ti system is qualitatively similar to the Re—Ti system and follows the generally observed dependence of transition temperatures on average group number and crystal structure. (auth)

11027 Intermetallic compounds of yttrium and hafnium with platinum. Holcombe, C.E. Jr. (Union Carbide Corp., Oak Ridge, TN). *J. Less-Common Met.*; **44**: 331-335(Jan 1976).

Preparation and structure of YPt_3, and $HfPt_3$, and $HfPt_5$ were investigated. Resulting data on physical properties and x-ray diffraction patterns for these compounds are given. It is noted that because of the high melting points and stabilities of high-Pt-content compounds such as $HfPt_3$ and $HfPt_5$, they may be used to contain reactive oxides in high-temperature x-ray diffraction experiments. (JRD)

11028 Reduction of ac losses of Nb_3Sn by surface treatment. Bussiere, J.F.; Suenaga, M. (Brookhaven National Laboratory, Upton, New York 11973). *J. Appl. Phys.*; **47**: No. 2, 707-714(Feb 1976).

Large reductions in the ac losses of Nb_3Sn were obtained by surface treatment of thick layers of Nb_3Sn formed by reacting Nb-1% Zr with liquid tin. The surface treatments studied were chemical etching, electropolishing, and mechanical polishing. The significant reduction in the losses is attributed to the removal, by polishing, of a porous outer layer of Nb_3Sn which forms at the Nb_3Sn—liquid-Sn interface and extends into the material. The porosity of this layer results in low surface and bulk current densities (hence high losses) compared with the material further away from the surface. Low losses (about 1 $\mu W/cm^2$ at 500 rms A/cm) can be obtained by fine mechanical polishing, electropolishing, or chemical etching of the surface. Mechanical polishing can produce the smoothest surfaces but introduces damage beneath the surface which is detrimental to achieving very low losses. When this damaged layer is either etched away or annealed, however, the losses can be made smaller than 1 $\mu W/cm^2$ at 500 rms A/cm. The lowest losses were obtained by annealing after rather coarse mechanical polishing. This behavior is attributed to the creation of new pinning centers near the surface after cold working and annealing. (AIP)

11029 Superconducting copper-base alloy containing filaments of V_3Ga. Chen, W.Y.K.; Tsuei, C.C. (California Institute of Technology, Pasadena, California 91109). *J. Appl. Phys.*; **47**: No. 2, 715-720(Feb 1976).

Superconducting copper-rich composites containing V_3Ga filaments have been prepared by a process which consists of melting the constituent elements into ingots followed by subsequent cold working and heat treatment. The composites were fabricated into 1x1-mm rods, 0.25x3-mm ribbons, and 0.4-mm wires. The superconducting transition temperature is about 13°K. The critical current density, J/subc/, at 4.2°K and zero field is as high as 2.9×10^4 A/cm² and decreases to 2×10^3 A/cm² at 60 kG. J/subc/ was found to decrease only slightly with temperature up to 9°K. (AIP)

11030 No giant two-ion anisotropy in the heavy-rare-earth metals. Lindgard, P. (Ames Laboratory-ERDA and Department of Physics, Iowa State University, Ames, Iowa 50010). *Phys. Rev. Lett.*; **36**: No. 7, 385-388(16 Feb 1976).

A new Bose-operator expansion of tensor operators is applied to the heavy-rare-earth metals. The Er data for the cone phase have been analyzed and found to reflect single-ion anisotropy and isotropic exchange interaction. The Tb data can be understood on the same basis. The previously found large two-ion anisotropy was due to an inadequate treatment of the large single-ion anisotropy leading to an incorrect expression for the spin-wave energy. (AIP)

11031 Alloys of Sn and Ge on Nb surfaces. Strozier, J.A.; Miller, D.L.; Kammerer, O.F.; Strongin, M. (Brookhaven National Laboratory, Upton, New York 11973). *J. Appl. Phys.*; **47**: No. 4, 1611-1615(Apr 1976).

An investigation of possible surface effects on the formation of the superconducting compounds Nb_3Sn and Nb_3Ge is reported. Low-energy electron diffraction and Auger electron spectroscopy were used to determine the symmetries and approximate compositions of surface compounds formed by reactions of fractional monolayers of Sn and Ge with the Nb100 and Nb110 surfaces. A number of ordered surface structures were observed for each of these elements when reacted with Nb, but epitaxial growth of Nb_3Sn or Nb_3Ge was not observed. With deposition of sufficient Sn, a disordered growth of Nb_3Sn crystallites was obtained at temperatures up to 940°C; however, deposits of Ge greater than about one atomic layer diffused into the Nb interior when heated, and no bulk Nb-Ge compounds were observed.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 10392, 10470, 10499, 10511, 10523, 10562, 10698, 11138

11032 (COO—2313-4) Liquid lithium corrosion research. Progress report, April 1, 1975—December 31, 1975. Olson, D.L.; Bradley, W.L. (Colorado School of Mines, Golden (USA)). 1975. Contract E(11-1)-2313. 29p. Dep. NTIS $4.50.

Kinetics for grain boundary penetration and weight loss were determined for 304L stainless steel in Ti-gettered liquid Li. Empirical weight loss rate coefficient expressions were determined as function of both N content and temperature which predict the weight loss behavior of stainless steel for Li with high N content. Capillarity was eliminated as a possible driving force for grain boundary penetration of Fe by Li with the evidence of a grain boundary groove. Coupled ionic diffusion in a corrosion product surface film is suggested as the controlling mechanism for grain boundary grooving of Fe in N-contaminated liquid Li. Stress-enhanced grain boundary penetration showed that the penetration of stressed Fe is a function of t sup 1/3 rather than t sup 1/2, suggesting that primary creep of the Fe is continually breaking the protective corrosion product in the grain boundaries. A new purification procedure and systems were designed and constructed to achieve very low N contents in the liquid Li (less than 300 ppM N). A gas purification train, based on a molten Al bubbler for the removal of O and N, was designed and built, and vacuum melting of as-received Li and gettering are being initiated. Experiments designed to determine the role of Cr in stainless steel resistance are in progress. Also experiments have been designed which will investigate how liquid metal corrosion is a function of the contact potential between the metals. (auth)

11033 (COO—2576-2) Elastic and plastic strains and the stress corrosion cracking of austenitic stainless steels. Progress report, April 30, 1975—December 30, 1975. Troiano, A.R. (Case Western Reserve Univ., Cleveland, Ohio (USA)). Dec 1975. Contract E(11-1)-2576. 20p. Dep. NTIS $3.50.

Homogeneous deformation of type 310 austenitic stainless steel only slightly influenced the corrosion potential in a boiling 3 percent NaCl aqueous environment. The difference in a deaerated solution was of the order of 25 mV and somewhat more for an aerated solution. Elastic strains appeared to have little or no influence on the corrosion potential for fully annealed as well as 10 percent and 25 percent homogeneously deformed 310 steel. Oxygen in the environment shifted the corrosion potential several hundred millivolts in the less active direction. The critical cracking potential in a deaerated 3 percent NaCl solution was approximately the same for the annealed and homogeneously deformed specimens at approximately -125 mV SCE.

11034 (DP-MS—76-10) Influence of microstructure on stress corrosion cracking of mild steel in synthetic caustic-nitrate nuclear waste solution. Sarafian, P.G. (Georgia Inst. of Tech., Atlanta (USA)). Dec 1975. 214p. Dep. NTIS $7.75.

Thesis.

The influence of alloy microstructure on stress corrosion cracking of mild steel in caustic-nitrate synthetic nuclear waste solutions was studied. An evaluation was made of the effect of heat treatment on a representative material (ASTM A 516 Grade 70) used in the construction of high activity radioactive waste storage tanks at Savannah River Plant. Several different microstructures were tested for susceptibility to stress corrosion cracking. Precracked fracture specimens loaded in either constant load or constant crack opening displacement were exposed to a variety of caustic-nitrate and nitrate solutions. Results were correlated with the mechanical and corrosion properties of the microstructures. Crack velocity and crack arrest stress intensity were found to be related to the yield strength of the steel microstructures. Fractographic evidence indicated pH depletion and corrosive crack tip chemistry conditions even in highly caustic solutions. Experimental results were compatible with crack growth by a strain-assisted

anodic dissolution mechanism; however, hydrogen embrittlement also was considered possible. (auth)

11035 (MDC-G—4442) **Refractory-alloy compatibility with curia-244 at 1800° and 2000°C.** Watrous, J.D.; Walker, J.C. (McDonnell Douglas Astronautics Co., Richland, Wash. (USA). Donald W. Douglas Labs.). Contract AT(45-1)-2138. 38p. Dep. NTIS $4.00.

Investigation of candidate refractory alloy compatibility with curium-244 sesquioxide at 1800 and 2000°C demonstrated containment capability for times in excess of a year. Refractory alloy composition (W, W—25Re, Mo, Mo—46 Re, and W—30Mo—30Re), temperature at time (2000°C for 1000 and 10,000 h, and 1800°C for 12,000 h) were the three variables studied. The test specimens consisted of 0.25-g fuel pellets in contact with two polished metal discs, all in a thick-wall sealed pressure vessel container of the same alloy. Attack depths ranged from less than two mils for the best containers to greater than fifteen mils for the poorest containers. Observed modes of attack included surface roughening, by solution or corrosion mechanisms, and a combination of subsurface voids and precipitates, caused by helium injection, oxygen diffusion, and metallurgical instability. Significant amounts of both curia and container alloys mass-transported within the capsules. The curia structure was changed in appearance, presumably because of oxygen loss by permeation through container walls, particularly those rich in molybdenum. The test configuration and container oxygen permeability at the very high test temperatures are believed to have masked some experimental effects. Both Mo—46Re and W—30Mo—30Re exhibited two mils or less attack after 12,000 h at 1800°C. The Mo—46Re alloy also exhibited comparable behavior after 10,000 hr at 2000°C. Rhenium, based on short-term behavior at 2000°C, also appears to be a suitable container material. (auth)

11036 (ORNL/TM—4927) **Review of lithium iron-base alloy corrosion studies.** DeVan, J.H.; Selle, J.E.; Morris, A.E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 33p. Dep. NTIS $5.00.

An extensive literature search was conducted on the compatibility of ferrous alloys with lithium, with the emphasis on austenitic stainless steels. The information is summarized and is divided into two sections. The first section gives a brief summary and the second is an annotated bibliography. Comparisons of results are complicated by differences in lithium purity, alloy composition, alloy treatment, flow rates, and lithium handling procedures. For long-term application, austenitic stainless steels appear to be limited to about 500°C. While corrosion can probably not be decreased to zero, a considerable reduction to tolerable and predictable amounts appears possible. (auth)

11037 (WAPD-TM—1203) **Analysis of iodine stress corrosion cracking of Zircaloy-4 tubing.** Kreyns, P.H.; Spahr, G.L.; McCauley, J.E. (Bettis Atomic Power Lab., West Mifflin, Pa. (USA)). Feb 1976. Contract E(36-1)-GEN-14. 31p. Dep. NTIS $4.00.

A fracture mechanics approach to interpreting iodine-vapor stress-corrosion cracking (SCC) in unirradiated Zircaloy-4 tubing is presented in which crack velocities are related to the fourth power on the stress intensity factor, K/sub I/. The crack growth power law on K/sub I/ is shown to predict well the time-to-failure in internally pressurized Zircaloy-4 tubing at 360 and 400°C reported by Busby, Tucker and McCauley. The temperature dependency on iodine stress corrosion cracking in Zircaloy can be described by an Arrhenius-type equation in which the activation energy Q for recrystallized and cold-reduced Zircaloy was determined to be 42.9 kcal/mole and 35.9 kcal/mole, respectively. It is concluded that the geometry of the initial surface flaw, through its attendant elastic stress field, is directly responsible in controlling the SCC time-to-failure, cold working having a relatively small effect on increasing the susceptibility to SCC. Any effects of the fast neutron flux on iodine stress corrosion cracking of Zircaloy-4 tubing either in-reactor or out-of-pile are still unknown.

11038 **Refractory metals for advanced gas turbine engines for combined cycle power production.** Boehman, L.I.; Davison, J.E. (Univ. of Dayton, OH). pp 62-67 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

An increase in the thermal efficiency of gas turbine engines through the application of refractory metals such as molybdenum is examined. The chemical compositions of the gaseous environments required in the turbine section which will prevent oxidation of molybdenum are discussed. The partial combustion of a fuel is found to provide a sufficiently high turbine inlet temperature to significantly increase the thermal efficiency and still provide the gaseous environment required to prevent oxidation of the molybdenum. The high temperature mechanical properties of molybdenum are reviewed and compared with existing nickel based superalloys which are currently used in gas turbine applications. The development of a molybdenum turbine will allow higher turbine inlet temperatures which will result in higher thermal efficiencies. The utilization of these gas turbines in the combined cycle consisting of a gas turbine whose exhaust gases are combusted in a steam boiler of the combined cycle will permit utilization of the full heating value of the fuel and will result in a higher thermal efficiency of the overall cycle.

11039 **Correlation of the surface layer stress coefficient and stress corrosion cracking. I.** Kramer, I.R. (Navy Ship Research and Development Center, Annapolis). *Corrosion;* **31**: No. 11, 383-390(Nov 1975).

The time to failure, the crack propagation velocity, and the surface layer stress of titanium (6Al—4V) and a 4130 steel were measured as a function of applied potential and concentration in solutions of HCl-CH_3OH and NaCl. Compact tension specimens were used in the SCC tests. It is shown that a direct correlation, independent of the applied potential or solution concentration, exists between the surface layer stress and SCC. The data show that the resistance to stress corrosion cracking (SCC) decreases under conditions that enhance the strength of the surface layer. It appears that SCC occurs when the environmenal conditions raise the surface layer stress coefficient above a critical value. (auth)

11040 **Correlation of the surface layer stress coefficient and stress corrosion cracking. II.** Kramer, I.R. (Navy Ship Research and Development Center, Annapolis). *Corrosion;* **31**: No. 11, 391-394(Nov 1975).

Analytical expressions are presented that relate the crack velocity and the failure time to the surface-layer stress coefficient for compact-tension specimens of Ti—6Al—4V and a 4130 steel subjected to stress corrosion cracking (SCC). The experimental data for the threshold stress intensity factor and the crack velocities for various stress intensity factors agree well with the calculated values. (auth)

11041 (BNWL-tr—163) **Oxygen surface film formation on steel in neutral saltfree water.** Freier, R.K. 16 Dec 1975. Translation of pp 11-17 from VGB feedwater conference, Essen, Germany, 1969. 18p. Dep. NTIS $3.50.

The kinetics for the formation of oxide protective films on steel were studied. The results showed that even at room temperature the reaction of Fe with oxygen dissolved in water can be used to obtain magnetite films. The most favorable redox potential for the film deposition was determined and it was shown that the film growth can be controlled by oxygen consumption. There is a definite relationship between the dissolved Fe concentration, the redox potential, and the pH value and also between the Fe content and electrical conductivity in front of and behind the cation filter. (JSR)

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 10481, 10665, 12103

11042 (AD/A—008337) **Cooperative radiation effects simulation program. Semiannual progress report, 1 May-31 Oct 1974.** Steele, L.E.; Wolicki, E.A. (Naval Research Lab., Washington, D.C. (USA)). Mar 1975. 89p. (NRL-MR—2998). NTIS $4.75.

See also report dated Jul 1974, AD—784403.

This seventh semiannual progress report, covering the period 1 May-31 October 1974, includes progress in: (1) extension of the NRL energy deposition code to high velocity ion bombardments, (2) modification of the NRL energy deposition code to correctly account for range straggling, (3) extension of the Johnson—Gibbons range code to calculate the lateral range of a PKA, (4) an investigation of the effect of ion dose on void and dislocation structures in nickel at elevated temperatures, (5) studies of dose rate effects on void formation and growth in 2.8 MeV nickel-ion-irradiated nickel, (6) studies of the effects of dilute solute elements on the swelling of nickel during nickel ion bombardment, (7) an experiment to investigate irradiation-induced creep of reactor structural alloys by cyclotron bombardment, (8) the electronic control system for the irradiation-induced creep experiment, and (9) the data processing system for the irradiation-induced creep experiment. (GRA)

11043 (CONF-751160—2) **Radiation-enhanced diffusion in metals and alloys.** Lam, N.Q.; Rothman, S.J. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 36p. Dep. NTIS $4.00.

From ASM seminar on materials science; Cincinnati, Ohio, United States of America *USA* (9 Nov 1975).

Some phenomena that involves diffusion during irradiation include fission2product redistribution in reactor fuels, defect clustering in CTR walls or fast-reactor cladding, smearing-out of gradients in ion-implanted semiconductors, and microstructure development in a HVEM. This paper is a review of the basics of radiation-enhanced diffusion (REM). The present status of REM today is somewhat the same as diffusion in the 1940's, and recommendations are made for further work. 105 references. (DLC)

11044 (CONF-751160—3) **Theory of defect clustering and void formation.** Wiedersich, H. (Argonne National Lab., Ill. (USA)). 1975. 41p. Dep. NTIS $4.00.

From ASM seminar on materials science; Cincinnati, Ohio, United States of America 'USA' (9 Nov 1975).

This paper reviews the current understanding of the mechanisms and phenomena that form voids and dislocation structures as a consequence of displacement damage and concurrent annealing processes which tend to restore thermodynamic equilibrium. An attempt is made to provide a qualitative explanation for the effects of parameters on void formation and on the development of the dislocation structure during irradiation. Steady-state conditions, nucleation, swelling, and sink-annihilation probabilities are discussed. 75 references. (DLC)

11045 (CONF-751164—2) **Defect production by energetic particle bombardment.** Merkle, K.L. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-Eng-38. 37p. Dep. NTIS $4.00.

From Conference on radiation damage in metals; Cincinnati, Ohio, United States of America 'USA' (9 Nov 1975).

Aspects of low-dose, low-temperature irradiation experiments, and elevated-temperature experiments are reviewed. Information and data are included on methods of determining lattice atom displacement thresholds, lattice damage rates measured by changes in resistivity, ion damage, and neutron damage. (JRD)

11046 (CONF-760209—10) **Correlation between blister skin thickness, the maximum in the damage-energy distribution, and projected ranges of helium ions in Nb for the energy range 10 to 1500 keV.** St-Jacques, R.G.; Martel, J.G.; Terreault, B.; Veilleux, G.; Das, S.K.; Kaminsky, M.; Fenske, G. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 16p. Dep. NTIS $3.50.

From 2. international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America 'USA' (16 Feb 1976).

The skin thickness of blisters formed on polycrystalline niobium by $^4He^+$ irradiation at room temperature for energies from 15 to 80 keV have been measured. Similar measurements were conducted for 10 keV $^4He^+$ irradiation at 500°C to increase blister exfoliation, and thereby allow examination of a larger number of blister skins. For energies smaller than 100 keV the skin thicknesses are compared with the projected range and the damage-energy distributions constructed from moments interpolated from Winterbon's tabulated values. For energies of 10 and 15 keV the projected ranges and damage-energy distributions have also been computed with a Monte Carlo program. For energies larger than 100 keV the projected ranges of $^4He^+$ in Nb were calculated using either Brice's formalism or the one given by Schiott. The thicknesses for 60 and 80 keV, and those reported earlier for 100 to 1500 keV correlate well with calculated projected ranges. For energies lower than 60 keV the measured thicknesses are larger than the calculated ranges.

11047 (COO—1367-72) **Irradiation softening in pure iron single crystals.** Meshii, M. (Northwestern Univ., Evanston, Ill. (USA). Dept. of Materials Science and Engineering). 1975. 14p. (CONF-750952—4). Dep. NTIS $3.50.

From Seminar on radiation-produced defects and defect clusters and their effects in metals; Ames, Iowa, USA (28 Sep 1975).

The characteristics of irradiation softening in Fe were studied. Results show that irradiation softening effect can be explained by the intrinsic mechanism, namely, the interaction of screw dislocations with randomly dispersed interstitials. At least some of the solid solution softening phenomena observed in alloys can be explained by the same mechanism. However, the alloying may be accompanied by an additional effect such as solute segregation to dislocations which may also strongly affect the yield stress. This effect may mask the softening effect partially or totally. Changes in the dislocation structure of deformed specimens caused by alloying, which are often reported in electron microscopic investigations, support this contention. The alloying, therefore, may not be as good as the low temperature irradiation in studying the effect of random solutes on dislocation motion and yield stress. (auth)

11048 (COO—2317-4) **Study of ferrite formation in neutron irradiated austenitic stainless steels. Progress report, March 1, 1975—February 29, 1976.** Stanley, J.T.; Hendrickson, L.E. (Arizona State Univ., Tempe (USA)). 1976. Contract AT(11-1)-2317. 21p. Dep. NTIS $3.50.

Magnetization measurements were carried out on a number of neutron-irradiated austenitic stainless steel specimens. Variation of magnetization with field indicates that the magnetic phase particles are very small so that the particles show superparamagnetic behavior. The temperature dependence of the magnetization indicates that more than one ferromagnetic phase may be present in some of the specimens. Postirradiation annealing at 500°C increased the quantity of magnetic phase in specimens that had been irradiated at 425°C and annealing in a magnetic field of 33 kOe has the effect of increasing the total quantity of magnetic phase but reducing the average size of the magnetic particles. (auth)

11049 (LBL—3922) **Climb of prismatic loops in Cu—Al alloys during irradiation in the HVEM.** Kosel, T.; Washburn, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-Eng-48. 8p. (CONF-751006—25). Dep. NTIS $3.50.

From International conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

Nucleation and growth of prismatic interstitial loops was observed during irradiation in the HVEM at different temperatures and damage rates. The loops remained rhombus shaped throughout growth, with sides lying on (111) planes, suggesting low jog densities. Weak-beam electron micrographs showed that the loops were dissociated on the (111) planes containing the loop sides. A minimum damage rate, PHI/sub min/, was found to be necessary to induce growth at measurable rates. This, together with the low jog densities observed, was taken to indicate that the climb rate was affected by the rate of jog nucleation, rather than controlled entirely by the rate of diffusion of point defects to the dislocations. PHI/sub min/ was found to be smaller for alloys of higher stacking fault energies, probably due to the influence of stacking fault energy on the energy of jog formation on an extended dislocation. The growth rate was found to be constant for individual loops observed over a large size range, suggesting that jog nucleation occurred preferentially at loop corners. (auth)

11050 (NTIS/PS—75/661) **Ion implantation. A bibliography with abstracts. Search period covered: 1964—August 1975.** Reimherr, G. (National Technical Information Service, Springfield, Va. (USA)). Aug 1975. 191p. NTIS $25.00.

Reports are cited which discuss research concerning ion implantation, particularly as applied to the microelectronics field. Specific topics include equipment, techniques, semiconductor doping, and radiation effects on material properties. 140 abstracts. (auth)

11051 (UCID—17021) **DT fusion neutron irradiation of BNL-LASL superconductor wires, UW-LLL metallic foils, and LLL copper tensile specimens.** MacLean, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Oct 1975. Contract W-7405-Eng-48. 10p. Dep. NTIS $3.50.

The irradiations were carried out in the LLL Rotating Target Neutron Source. The order of stacking of the specimens is given. Fluences for the dosimetry foils were calculated and are given. (DLC)

11052 **Fatigue crack growth resistance of several neutron irradiated pressure vessel steels and welds.** Shahinian, P.; Watson, H.E.; Hawthorne, J.R. (Naval Research Lab., Washington, DC). *J. Eng. Mater. Technol.*; **96**: No. 4, 242-248(Oct 1974).

Pre and postirradiation fatigue crack growth rates in A302-B, A533-B, and A543 steel plate and in two A543 welds (submerged arc and electroslag) were determined at 550°F in air. The fracture mechanics approach was used to analyze the experimental data. Neutron irradiation at 585°F to 2.5×10^{19} n/cm^2, greater than 1 MeV produced no significant effect on resistance to crack growth in A302-B steel and caused only a slight decrease in crack growth resistance of A533-B and A543 steels. Also, the resistance to crack growth of the submerged arc weld was unaffected by the irradiation, but that of the electroslag weld was substantially improved. The crack growth rate versus stress intensity factor range curve for the A302-B steel represents an upper bound for the pre and postirradiation data for the steels and welds of this study. (auth)

11053 **Defect dragging by dislocations. Theory and experiment in the amplitude independent and dependent regions.** Sosin, A. (Univ. of Utah, Salt Lake City). pp 109-133 of In Internal friction and ultrasonic attenuation in crystalline solids. Vol. II. Lenz, D. (ed.). Berlin; Springer-Verlag (1975).

From Conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F.R. Germany (27 Aug 1973).

See CONF-730844—P2.

In the theory of "defect dragging", account is made for the contributions to internal friction (decrement) and to elastic moduli by the dragging of point defects attached to dislocation lines as the dislocation segments are bowed by an applied stress. Experiments are also reviewed. The dragging model accounts for the observed frequency dependence of decrement in the low (few kHz and below) frequency range. The model also predicts the initial increase in decrement (peaking effect) found on bombardment in copper, aluminium, and probably tungsten. The peaking effect, a function of temperature of irradiation and pre-irradiation sample history, is vividly present in copper, concomitant with a rapid, monotonic decrease in the modulus defect—as predicted by the dragging model. In aluminium, the increase is substantially slower and, at cryogenic temperatures above 78°F, the modulus defect shows very little variation. These observations in aluminium are also consistent with the dragging model. In fact, copper and aluminium samples that have been studied provide support for the dragging model in different value ranges of a universal parameter which includes frequency of measurement, damping constants for dragged point defects and dislocation segments, dislocation loop length, and dislocation line tension. (auth)

11054 Effects of electron irradiation on precipitation in Al—3.5% Cu. Sklad, P.S.; Mitchell, T.E. (Case Western Reserve Univ., Cleveland). *Acta Metall.*; **23**: No. 11, 1287-1302(1975).

The effects of electron irradiation on precipitation in Al—3.5 percent Cu was studied in the temperature range 20—200°C by high voltage electron microscopy. G. P. zones gradually disappear during irradiation and are replaced by theta' precipitates. The intermediate stage of theta'' precipitation is inhibited by irradiation. If theta'' precipitates are introduced by preaging, they are also gradually replaced by theta' precipitates during irradiation, even in the temperature range where they would normally grow. The growth of theta' precipitates is observed to be enhanced at all temperatures between 20 and 200°C (above 200°C the growth rate is normal), especially at the lower temperatures. In fact, the growth rate is approximately constant between 20 and 120°C where essentially no growth is observed under normal aging. These results are explained in terms of a model of enhanced diffusion resulting from the annihilation at fixed sinks of the vacancies and interstitials created by irradiation; the fixed sinks are the precipitates themselves. The irradiating conditions in the microscope are shown to give rise to a constant contribution to the diffusion coefficient, D/sub rad/ approximately equal to 2×10^{-16} cm² s for the temperature range 20—120°C. Irradiation also gives rise to small dislocation loops in either the quenched or the aged condition, but these are only observed at room temperature. Voids are never observed; apparently, the precipitates act as sinks for both the vacancies and interstitials. (auth)

11055 Influence of sodium and radiation on the creep and fatigue of fast reactor components. Weeks, R.W.; Kassner, T.F.; Weins, J.J. (Argonne National Lab., IL). pp 229.1-229.8 of In Creep and fatigue in elevated temperature applications. Volume I. New York; Mechanical Engineering Publications (1975).

From International conference on creep and fatigue in elevated temperature applications; Philadelphia, Pennsylvania, USA (23 Sep 1973).

See CONF-730916—P1.

Information on the effects of Na and irradiation on creep-fatigue properties of austenitic stainless steels is reviewed. It is noted that the sodium coolant in a fast breeder reactor acts as a mass transfer agent, nominally carrying carbon and nitrogen from the hotter parts of the system to the cooler parts, causing decarburization/denitridization and carburization/nitridization of the components in the respective parts. Although there is a severe lack of data, it is evident that decarburization results in a reduction in tensile and creep strength, but with an increase in ductility that should increase low-cycle fatigue resistance. Carburization, of course, results in the opposite effects. Radiation tends to increase the tensile and creep strength of austenitic stainless steels, while the ductility decreases correspondingly. These property changes are consistent with a reduction in low-cycle fatigue life found in postirradiation testing. From the limited data available, it is obvious that the interaction of the effects of sodium and irradiation should be of major concern to reactor designers. The potential magnitude of the deterioration in mechanical properties of austenitic stainless steels exposed to such a reactor environment dictate that a much better understanding and quantification of these effects be obtained, particularly at high temperatures. In addition, considerable effort should be devoted to screening alternate alloys that have improved resistance to the reactor environment. The acute shortage of data in the areas of fatigue and creep-fatigue interactions of materials in a sodium environment results in a high degree of design uncertainty. It is anticipated that this circumstance will be resolved during the next few years; however, a greatly accelerated program might lead to a substantial return in terms of reduced design penalties. (auth)

11056 Fast- and thermal-neutron irradiation and annealing of Cu, Ni, Fe, Ti, and Pd. Horak, J.A.; Blewitt, T.H. (Argonne National Lab., IL). *Nucl. Technol.*; **27**: No. 3, 416-438(Nov 1975).

Concentrations of lattice point defects produced by thermal-neutron and fast-neutron irradiation of copper, nickel, iron, titanium, and palladium at 4.5°K were measured resistometrically, and the values are compared with the theoretically predicted values. For thermal-neutron irradiation the ratio of the predicted to measured concentration of defects ranged from a minimum of 1.0 for titanium to a maximum of 4.5 for palladium; for fast-neutron irradiation this ratio ranged from 2.3 for titanium to 6.5 for copper. On postirradiation isochronal annealing no stage II or V are present in copper after thermal-neutron irradiation, but both these stages are present after fast-neutron irradiation. Both nickel and titanium exhibit more than 100 percent recovery, super-recovery, after thermal-neutron irradiation. The super-recovery is attributed to the irradiation-induced supersaturation of vacancies that provide the enhanced diffusion required for the precipitation of impurity atoms from the lattice. Little or no enhanced diffusion is observed after fast-neutron irradiation of nickel and titanium. (auth)

11057 Influence of irradiation conditions and impurities on neutron damage in molybdenum. Sikka, V.K. (Oak Ridge National Lab., TN); Moteff, J. *Trans. Am. Nucl. Soc.*; **22**: 214-216(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

11058 Effects of large concentrations of helium on the mechanical properties of neutron-irradiated stainless steel. Bloom, E.E.; Wiffen, F.W. (Oak Ridge National Lab., Tenn. (USA)). *J. Nucl. Mater.*; **58**: No. 2, 171-184(Nov 1975).

Tensile and creep properties have been determined on specimens of type 316 stainless steel irradiated in the High Flux Isotope Reactor in the range 380 to 785°C. Irradiation of type 316 in this reaction partially simulates fusion reactor irradiation, with displacement damage levels up to 120 dpa and helium contents up to 6000 appM achieved in two years. Samples irradiated in the annealed condition to about 100 dpa and 4000 appM helium showed an increased yield strength between 350 and 600°C and, except at 350°C, a reduced ultimate tensile strength compared with values for the unirradiated material. Samples irradiated in the 20 percent-cold-worked condition showed decreases in both yield and ultimate tensile strengths at all test temperatures. The irradiated samples of both annealed and cold-worked material exhibited little strain hardening. Total elongations were small and became zero for tests at 650°C. Tensile tests at 575°C and creep-rupture tests at 550°C showed strong effects of fluence on strength and ductility for helium contents above about 30 appM. Optical metallography showed extensive carbide precipitation at all temperatures and precipitation of a second phase, believed to be sigma, at the high temperatures. (NL)

11059 Elastic interactions between "voids" induced by solute segregation. Nolfi, F.V. Jr. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Appl. Phys.*; **47**: No. 1, 24-36(Jan 1976).

Expressions are derived for the elastic interaction energy between void-solute shell composites. These composites consist of spherical void cores surrounded by spherically symmetric solute shells containing a uniform concentration of irradiation segregated solute. The solutes are assumed "misfitting" and as such represent sources of internal stress. The elastic interaction energy between composites arises because of the so-called inhomogeneity interaction and has minimum values at certain composite separations and solute shell thickness. The existence of these minima obtains largely because the misfit of the composites increases as the composite separation R increases. For a constant misfit, the interaction energy would decrease monotonically approximately as R^{-6}. The surface stress of voids is taken to be zero in the calculations so that the only source of interaction between composites is the stress induced by solute segregation. The calculations are performed for both two-composite and N-composite interactions, and we show that, primarily, only nearest-neighbor interactions are significant. The calculations are compared with experimental investigations of void ordering in an Ni ion-irradiated Nb-1Zr alloy containing 0.0038 atom fraction of oxygen as an impurity. Given experimentally determined void sizes and auxiliary data, the correct void lattice parameter is pre-dicted when the solute shell thickness is

~30% of the composite radius. In pure Nb, it is found the O, C, or N impurities are necessary for void ordering, which supports the main thesis of the present paper, viz., solutes/impurities are a primary cause of void ordering. (AIP)

11060 Drift mobility of holes in n-type germanium bombarded by fast neutrons. El-Difrawi, A.A.; Yeh, T.H.; Christopher, J.E.; Gossick, B.R. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506). *J. Appl. Phys.*; **47**: No. 1, 272-276(Jan 1976).

A surface effect which depends on exposure to fast neutrons is introduced. This effect makes the apparent drift mobility of holes in germanium increase under certain conditions following irradiation by fast neutrons, but the bulk mobility never increases. Thus, contrary to a simple model for disordered regions in n-type germanium, these regions do not act like short circuits for holes. (AIP)

11061 Depth-resolved cathodoluminescence of ion-implanted layers in zinc oxide. Pierce, B.J.; Hengehold, R.L. (Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio 45433). *J. Appl. Phys.*; **47**: No. 2, 644-651(Feb 1976).

Single-crystal substrates of ZnO prepared from a large boule of hydrothermally grown material were implanted with ions of Li, Na, N, P, and Ne using energies in the range 30 keV to 1 MeV and doses of $1x10^{11}$ to $1x10^{16}$ ions/cm^2 using substrates maintained at either room temperature or 475°C. These implanted layers were studied using depth-resolved cathodoluminescence. The spectra obtained agreed well with those expected based on a comparison of theoretical electron-hole pair profiles and computer-generated ion implantation profiles. The spectra of all samples implanted at 475°C exhibited a peak near 6500 A, and a series of previously unreported phonon-coupled peaks analogous to the well-known CdS edge emission was observed to some extent in all the implanted samples, independent of implant species. The luminescence could be quenched by annealing above 600°C and is probably a result of the formation of damage centers. (AIP)

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 10959, 11268

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 10303, 10305, 10306, 10308, 10359, 10965, 10967, 11091

11062 (FRNC-CONF—130) **Experimental investigations of sintering of ceramic compounds prepared by lyophilisation.** Lacour, C.; Guillaume, L.; Tromson, A.; Paulus, M. (Centre National de la Recherche Scientifique, 92 - Meudon-Bellevue (France)). 1975. 7p. (In French). INIS.

From 4. European symposium for powder metallurgy; Grenoble, France (13 May 1975).

A method of preparation of ceramic compounds, which leads to an extremely small porosity (0.3 to 2 percent) for sintering temperatures 200 to 300°C below the usual temperatures, is described. The ceramics obtained are chemically homogeneous. They have fine crystals and their micro-structural evolution is identical to that of classical ceramics. This method is applied to some defined compounds (Mn, Ni, and Zn ferrites, Mg aluminate) for which the influence of composition is studied. The influence of an impurity on the sintering rate is emphasized. (FR)

11063 (LA-tr—75-35) **Preparation and properties of transition metal carbides in their homogeneity ranges.** Samsonov, G.V.; Naumenko, V.I.; Okhremchuk, L.N. Translated by A.D. Cernick from *Phys. Status Solidi (a)*; **6**: 201-211(1971). 19p. Dep. NTIS $3.50.

An investigation is made of the technology of obtaining IV and V group transition metal carbides in the homogeneity range and of properties of these carbides such as lattice parameters, electrical resistivity, microhardness, thermal expansion coefficient, and electron work function. The concentration dependences of microhardness, electrical resistivity, work function, and thermal expansion coefficient of the titanium, zirconium, hafnium, and vanadium carbides are established to have practically linear character, but in the case of niobium and tantalum carbides the curves of the concentration dependence of these properties show extrema for the ratio C/Me ≅ 0.8 to 0.85. Changing of these properties in the homogeneity ranges are discussed in connection with the specific character of the electronic structures of the carbide phases investigated. (auth)

11064 Method for preparing thin-walled ceramic articles of configuration. Holcombe, C.E.; Powell, G.L. (to U.S. Energy Research and Development Administration). US Patent 3,917,782. 4 Nov 1975. Filed date 16 May 1973. 4p.

PAT-APPL-361,000.

A method for preparing a hollow thin-walled ceramic product is described. Ceramic powder is plasma-sprayed onto a concave surface of a substrate having a coefficient of thermal expansion less than that of the ceramic. The coated substrate is heated to sinter the ceramic and then cooled to effect a separation of the ceramic product from the substrate. (auth)

11065 Particle size of $^{238}PuO_2$ obtained by oxalate precipitation and calcination. Rankin, D.T.; Burney, G.A. (Savannah River Lab., Aiken, SC). *Am. Ceram. Soc. Bull.*; **54**: No. 12, 1061-1065(Dec 1975).

From Joint fall meeting of the basic science and nuclear divisions of the American Ceramic Society; Williamsburg, VA, USA (1 Oct 1974).

The factors determining particle size distribution and morphology during precipitation of ^{238}Pu oxalate and calcination to $^{238}PuO_2$ were investigated. The manner and rate of solution addition and the rate of mixing during precipitation were the key variables in controlling particle size. A decrease in particle size of calcined $^{238}PuO_2$ with aging time was also noted. (auth)

11066 Method for preparing actinide nitrides. Bryan, G.H.; Cleveland, J.M.; Heiple, C.R. (to U.S. Energy Research and Development Administration). US Patent 3,923,959. 2 Dec 1975. Filed date 28 Nov 1973. 4p.

PAT-APPL-419,833.

Actinide nitrides, and particularly plutonium and uranium nitrides, are prepared by reacting an ammonia solution of an actinide compound with an ammonia solution of a reactant or reductant metal, to form finely divided actinide nitride precipitate which may then be appropriately separated from the solution. The actinide nitride precipitate is particularly suitable for forming nuclear fuels.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 10989, 11138, 11139, 11158

11067 (BNL—20619) **First-order transitions, symmetry, and the ε-expansion.** Mukamel, D.; Krinsky, S.; Bak, P. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 37p. (CONF-751209—16). Dep. NTIS $5.00.

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

The group theoretical method of Landau and Lifshitz was used to derive effective Hamiltonians for certain paramagnetic to antiferromagnetic transitions having order-parameters with n greater than or equal to 4 components. A renormalization group analysis in 4-epsilon dimensions was performed. The first-order nature of the order-disorder transitions in Cr(n = 12), Eu(n = 12), UO_2(n = 6), and MnO(n = 8) can be explained by noting that the corresponding Hamiltonians possess no stable fixed points in 4-epsilon dimensions. It is predicted that all fcc type I(anti m perpendicular anti k), type II and type III(anti m perpendicular [100], anti k = [1/2 01]) antiferromagnetic transitions are first-order. The work is intended to serve as a guide in an experimental search for new examples of first-order transitions. A 2m-component Hamiltonian is also considered which possesses a unique, nonisotropic, stable fixed point for each value of 2m greater than or equal to 4. When 2m = 4, the Hamiltonian describes the paramagnetic to antiferromagnetic transitions in $TbAu_2$, DyC_2, Tb, Ho, Dy, and the structural transition in NbO_2. If these transitions are second-order, it is predicted they all belong to the same universality class. For 2m = 6, the Hamiltonian describes the antiferromagnetic transitions in TbD_2, Nd, K_2IrCl_6, and MnS_2. These transitions belong to a single universality class. (auth)

11068 (IS-T—702) **High temperature vaporization and thermodynamic study of the scandium—sulfur system.** Tuenge, R.T. (Ames Lab., Iowa (USA)). Jan 1976. Contract W-7405-eng-82. 196p. Dep. NTIS $7.50.

Thesis.

Results of studies on the stoichiometry, structure, vaporization behavior, and thermodynamic properties of the Sc—S system are reported. The thermodynamic results for the stability of ScS(s) are compared with reported results for other transition-metal and rare-earth monosulfides. Various models are discussed in regard to their ability to describe the bonding in these refractory solids. (JRD)

11069 (LBL—4114) **High voltage electron microscope studies of ceramic ferrites.** Thomas, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1975. Contract W-7405-eng-48. 11p. (CONF-750982—3). Dep. NTIS $3.50.

From 4. high voltage electron microscopy conference; Toulouse, France (1 Sep 1975).

Results of studies on defects and phase transformations in ceramic ferrites are presented. Data and information are included on order-disorder in lithium ferrite, high-temperature phase transformation in lithium ferrite, stacking faults in nickel ferrite, cation faults in lithium ferrite, and disassociated dislocations and stacking fault energy in lithium ferrite. (JRD)

11070 (SAND—75-8051) **Wetting of a polycrystalline alumina by glass.** Kramer, C.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1976. Contract AT(29-1)-789. 24p. Dep. NTIS $3.50.

Contact angles were measured in sessile drop experiments of Corning 7052 glass on various polycrystalline alumina substrates and on an alumina/niobium cermet substrate between 700 and 1100°C. The alumina-glass systems illustrated dynamic nonequilibrium situations. Solid state sintering by viscous flow of the glass was observed below 1000°C. Surface tension values were computed for the glass and ranged between 80 and 600 dynes/cm. (auth)

11071 **Transformational superplasticity in pure Bi_2O_3 and the Bi_2O_3—Sm_2O_3 eutectoid system.** Johnson, C.A. (General Electric Co., Schenectady, NY); Smyth, J.R.; Bradt, R.C.; Hoke, J.H. pp 443-453 of In Deformation of ceramic materials. Bradt, R.C.; Tressler, R.E. (eds.). New York; Plenum Press (1975).

From Symposium on plastic deformation of ceramics; University Park, Pennsylvania, USA (17 Jul 1974).

See CONF-740724—.

Results for Bi_2O_3 and the Bi_2O_3—Sm_2O_3 eutectoid show that ceramics can exhibit superplasticity analogous to that of metals. Results are in tentative agreement with the Greenwood and Johnson theory, but additional criteria must be met for ceramics to exhibit transformational superplasticity, a large transformational volume change to induce large internal stresses and the occurrence of the transformation at T/T/sub mp/ greater than or equal to 0.75. It is suggested that the process is a grain boundary sliding mechanism. (DLC)

11072 **Reply to comment 'The affinity of oxygen for two electrons'.** Cantor, S. (Oak Ridge National Lab., TN). *J. Chem. Phys.*; **62**: No. 11, 4584-4585(1 Jun 1975).

11073 **Neutron diffraction determination of the crystal structure of Ce_7O_{12}.** Ray, S.P. (Columbia Univ., New York, NY); Cox, D.E. *J. Solid State Chem.*; **15**: No. 4, 333-343(Dec 1975).

A neutron diffraction study has been made on polycrystalline and single crystal samples of $CeO_{1.714}$. The results confirm that the compound is isostructural with ternary oxides of the type UY_7O_{12}. The space group is R anti 3 with hexagonal unit cell dimensions a = 10.37 A and c = 9.67 A (rhombohedral cell a = 8.60 A and α = 99.4°). The hexagonal unit cell contains three formula units of Ce_7O_{12}. Totals of 79 and 24 independent reflections from the single crystal were measured at neutron wavelengths of 1.185 and 2.37 A, respectively. Simultaneous refinement of the two sets of data yielded a weighted R factor of 0.144. The structure is a rhombohedral defect type of fluorite arrangement in which pairs of oxygen vacancies are ordered along the [111] axis.

11074 **X-ray and neutron diffraction study of intermediate phases in nonstoichiometric cerium dioxide.** Ray, S.P. (Columbia Univ., New York, NY); Nowick, A.S.; Cox, D.E. *J. Solid State Chem.*; **15**: No. 4, 344-351(Dec 1975).

Powder samples of reduced ceria, CeO/sub 2 - x/, of known compositions in the range 0 less than x less than 0.3 have been examined by x-ray and neutron diffraction techniques in order to determine which intermediate phases belonging to the homologous series Ce/sub n/O/sub 2n - 2/ (with n = integer) truly exist. Through the appearance of superlattice lines in the neutron diffraction patterns, the existence of four distinct phases, corresponding to n = 7, 9, 10, and 11 was established. Aside from the phase Ce_7O_{12}, the structures of these phases cannot be accounted for with rhombohedral cells based on (111) vacancy strings, but indicate lower (monoclinic or triclinic) symmetry. The structure of Ce_9O_{16} and $Ce_{10}O_{18}$ do not agree with structures proposed for the analogous Pr/sub n/O/sub 2n - 2/ compounds.

11075 **Analysis of the vibronic spectrum of chromium doped strontium titanate.** Kim, Q. (Oklahoma State Univ., Stillwater); Powell, R.C.; Mostoller, M.; Wilson, T.M. *Phys. Rev., B;* **12**: No. 12, 5627-5642(15 Dec 1975).

The fluorescence spectrum of chromium-doped strontium titanate was measured as a function of temperature. The low-energy vibronic sideband of the R lines at low temperatures was analyzed to determine the one-phonon and multiphonon contributions to the observed spectral profile. The one-phonon spectrum appears to be predominantly forced electric dipole in nature. Vibronic selection rules appropriate for such transitions were determined, and by comparison with neutron scattering and infrared absorption data more than 30 peaks in the vibronic spectrum can be tentatively identified with transitions involving specific phonon modes. Numerous low-frequency peaks are observed in the high-energy vibronic sideband, many of which cannot be associated with known vibrational modes. Using a simple long-wavelength phonon approximation, a phonon density of states is obtained and found to compare quite well to that determined from analyzing neutron scattering data. The temperature dependences of the widths of the zero-phonon lines and local mode were investigated using several phonon distributions including the effective density of phonon states obtained from the vibronic sideband. Low-frequency modes appear to make the dominant contribution to the broadening of the zero-phonon lines, whereas both low- and high-frequency phonons are active in broadening the local mode. (auth)

11076 **Radial distribution function of amorphous iron—phosphorus alloys.** Logan, J. (California Inst. of Tech., Pasadena). *Phys. Status Solidi (a);* **32**: No. 2, 361-368(16 Dec 1975).

The density and radial distribution function of amorphous iron-phosphorus have been measured at four different compositions ranging from 14.5 to 21.6 atomic percent phosphorus. These alloys were produced by electrodeposition, and the density and radial distribution function are similar to other amorphous electrodeposited alloys. (auth)

11077 **Neutron-diffraction study of UO_2: Observation of an internal distortion.** Faber, J. Jr.; Lander, G.H.; Cooper, B.R. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.*; **35**: No. 26, 1770-1773(29 Dec 1975).

It was deduced from measurements of the neutron elastic cross section that below the Neel temperature (T/subN/) the oxygen atoms in UO_2 are shifted from their ideal fluorite positions. Quantitative agreement is found with experiment by assuming a rearrangement (internal shear deformation with amplitude 0.014 A) of the oxygen sublattice. The dominance of this deformation mode in the spin-lattice interactions suggests the presence of a noncollinear magnetic structure in UO_2. (AIP)

MECHANICAL PROPERTIES

11078 (COO—1591-29) **Impurity effects on the creep of polycrystalline magnesium and aluminum oxides at elevated temperatures. Technical progress report, December 19, 1974—December 18, 1975.** Gordon, R.S. (Utah Univ., Salt Lake City (USA). Div. of Materials Science and Engineering). Dec 1975. Contract E(11-1)-1591. 82p. Dep. NTIS $5.00.

Work is reported on: 1. Viscous creep of fine-grained MgO doped with iron. 2. The effects of transition metal impurities and grain size on the creep of polycrystalline Al_2O_3. 3. The non-viscous creep of large grain size MgO and Al_2O_3, pure and doped with transition metal impurities. 4. Stress relaxation tests on polycrystalline MgO and Al_2O_3, pure and doped with transition metal impurities. 5. The construction of creep deformation maps for polycrystalline MgO and Al_2O_3, pure and doped with iron. 6. Preliminary studies on the effect of grain size on the creep of polycrystalline mullite. Some of the significant findings include: 1. Power law creep (N ~ 3) in polycrystalline MgO is independent of iron doping, grain size, and oxygen partial pressure. 2. Three well-defined regimes have been identified for the diffusional creep of polycrystalline MgO and Al_2O_3, pure and doped with transition metal impurities: (1) cation grain boundary diffusion (2) cation lattice diffusion, (3) anion grain boundary diffusion. 3. Coble diffusional creep, which is rate-limited by oxygen grain boundary diffusion, has been identified in reduced iron-doped (2 cation percent) and double doped (1/4 percent Mn and 1/4 percent Ti) polycrystalline Al_2O_3. Stress relaxation deformation tests can be used to (1) identify transitions between viscous and non-viscous deformation, and (2) achieve high stresses (~ 10^3 kg/cm²) and strain rates ($1h^{-1}$) without fracture. Good agreement exists between dead-load creep and stress relaxation studies in four point bending. (auth)

11079 (LBL—3979) **High temperature deformation of MgO.** Dokko, C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 179p. Dep. NTIS $7.50.

Thesis.

The deformation and recovery of both single crystals ([100], [110], [111] and Ni-doped [100]) and fully dense polycrystals (with grain sizes ranging from 4 to 160 μm) of MgO were studied under compressive stress-strain and creep testing con-

ditions at 1200°C (0.48 Tm) and 1400°C (0.55 Tm). Emphasis was placed on the aspects relevant to ductility such as recovery contribution and the role of grain boundaries. No polycrystals were harder than a [111] crystal, nor softer than a [100] crystal, which represented dislocation glide on the more difficult and less difficult slip planes, respectively. Plastic anisotropy between these slip planes decreased and polycrystaline ductility increased with decreasing strain rate as well as increasing temperature. Simultaneous activation of all five independent slip systems did not lead to a large ductility. A maximum ductility was observed for the smallest grain size under given testing conditions. In addition to slip on both planes and dislocation-climb-aided accommodation, intergranular separation is suggested as a mode of accommodation, although it was accompanied by weakening effects. Significance of grain boundary nature, per se, was indicated by variability of the mechanical behavior as a function of prior annealing history for the same grain size. (auth)

11080 Drag mechanisms controlling dynamic dislocation behavior in MgO single crystals. Singh, R.N. (Massachusetts Inst. of Tech., Cambridge). pp 217-231 of In Deformation of ceramic materials. Bradt, R.C.; Tressler, R.E. (eds.). New York; Plenum Press (1975).

From Symposium on plastic deformation of ceramics; University Park, Pennsylvania, USA (17 Jul 1974).

See CONF-740724—.

Edge and screw dislocation velocities in "pure" and iron-doped magnesium oxide single crystals, with and without dislocation dipoles, were measured as a function of stress, temperature, and valence state of the iron impurities to identify the rate-controlling drag mechanisms for dislocation mobility. Edge dislocations were observed to move faster than screw dislocations. The edge and screw dislocations move faster in reduced (Fe^{+2}) samples than in oxidized (Fe^{+3}) samples. It is suggested that the edge and screw dislocation mobilities in "pure" MgO single crystals in the reduced state are controlled by Peierls mechanism, with thermally activated double-kink nucleation as the rate-limiting step. Calculated Peierls stresses for edge and screw dislocation mobilities in "pure" MgO crystals in the reduced state are 0.6×10^8 and 1.7×10^8 Nm^{-2}, respectively. In crystals containing 150 ppM Fe^{+2} dopants, the edge and screw dislocation mobilities are controlled by the interaction of dislocations with the noncentrosymmetric distortions due to (Fe/sub Mg/—V/sub Mg/) defects. The strain $\Delta\epsilon$ owing to such defects is calculated and is related to the observed hardening of iron-doped (Fe^{+2}) MgO single crystals. Screw dislocation mobility in crystals containing dislocation dipoles and 90 ppM oxidized Fe is controlled by interaction of dislocations and noncentrosymmetricdefects. Edge dislocation mobility in oxidized state and edge and screw dislocation mobilities in reduced state are probably controlled by the interaction of dislocations with dislocation dipoles. (DLC)

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 10546, 10921, 11017, 11063, 11221, 11392, 11751

11081 (AD/A—008438) **The thermodynamics of thorium-oxygen and uranium-oxygen systems. Final report, 14 Jun 1973-30 Jun 1974.** Abramowitz, S. (National Bureau of Standards, Washington, D.C. (USA)). 19 Feb 1975. 30p. NTIS $3.75.

The vapor pressure data for the uranium—oxygen and thorium—oxygen systems have been reviewed. Free energies of formation for the species UO, UO_2, ThO, and ThO_2 have been chosen. Tables of thermodynamic functions for these species are presented. (GRA)

11082 (HEDL-TME—75-104) **Thermal properties of B_4C and Eu_2O_3.** Gibby, R.L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1975. Contract AT(45-1)2170. 22p. AT.

The enthalpy and heat capacity of B_4C have been determined between room temperature and approximately 1500°C for both irradiated and unirradiated samples. An effect of irradiation on the measured enthalpy was not observed. The thermal diffusivity and thermal conductivity of approximately 92 percent theoretical density Eu_2O_3 were determined between room temperature and approximately 1300°C. The thermal conductivity of cubic Eu_2O_3 was approximately 19 percent higher than that of the monoclinic form at 100°C, but approaches the thermal conductivity of the monoclinic form at the cubic-monoclinic transition temperature (1050°C). (auth)

11083 (IS-T—691) **Self-diffusion of Co^{60} in crystals of Co/sub 1-x/O.** Rahman, S.F. (Ames Lab., Iowa (USA)). Jan 1976. Contract W-7405-Eng-82. 138p. Dep. NTIS $6.00.

Thesis.

Tracer self-diffusion coefficients were measured as functions of temperature and deviations from stoichiometry. The arc-transfer technique of crystal growth was found to produce crystal of Co/sub 1-x/O of essentially the same purity as the starting Co rod, and the quality was comparable to commercially available crystals grown by Verneuil process. Measurements at $x = 0.005$ in Co/sub 1-x/O showed the Co tracer self-diffusion coefficient to be $D = 3.88 \times 10^{-4} \exp(-31600 +\text{-} 2400/RT)$ cm^2/s between 1037 and 1350°C. This activation energy is in agreement with measurements made in air, if proper compensation is made for the effect of variation in stoichiometry. Measurements on crystals having deviations between 0.002 and 0.008 at 1150°C showed the diffusion coefficient to depend on p/sub O_2/ as $D = 9.74 \times 10^{-9}$ p/sub O_2/sup 1/(3.59)/ cm^2/s, where p/sub O_2/ varied between $10^{-1.5}$ and $10^{-9.15}$ atm. Comparison with thermogravimetric and electrical conductivity measurements confirms that the defects responsible for Co diffusion in the range of temperature and p/sub O_2/ of this investigation are singly ionized cobalt vacancies. The Co tracer self-diffusion coefficients in single crystals are nearly identical to those in polycrystalline Co/sub 1-x/O. 53 references, 29 fig, 6 tables (DLC)

11084 (LBL—4102) **Far infrared spectroscopy of solids. I. Impurity states in Al_2O_3. II. Electron-hole droplets in Ge.** Aurbauch, R.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 12 Sep 1975. Contract W-7405-Eng-48. 229p. Dep. NTIS $8.00.

Thesis.

Far infrared Fourier transform spectroscopy was used to study the low lying vibronic states of Mn^{3+} in Al_2O_3 and the plasma absorption of electron-hole droplets in Ge. The transmission of Mn-doped samples of Al_2O_3 was measured in the frequency range from 3 to 30 cm^{-1} in applied magnetic fields up to 50 kG. Absorption lines were observed due to both ground and excited state transitions. Polarization measurements established that these absorption lines were due to electric dipole transitions. Temperature dependence measurements were used to derive a level diagram for the low lying states of Mn^{3+}. A phenomenological model based on an electronic Hamiltonian was developed which successfully describes the data. The empirically determined trigonal field and spin-orbit quenching parameters of this model are 0.7 and 0.1 respectively. This quenching is attributed to the dynamic Jahn—Teller interaction. The plasma absorption of small (α) electron-hole drops in Ge was measured in the frequency range from 30 to 300 cm^{-1}. The observed absorption is in good agreement with measurements by Vavilov and other workers. A theoretical model which includes both intraband and interband contributions to the dielectric constant in the Rayleigh limit of Mie theory is used to describe the observed lineshape. Measurements of plasma absorption of large (γ) drops in inhomogeneously stressed Ge were made in magnetic fields up to 50 kG. The lineshape at zero applied field was calculated in the large sphere limit of Mie theory including intraband terms and a zero-strain interband term. Qualitative agreement with experiment was obtained. The peak absorption shifted quadratically with applied magnetic field and the total plasma absorption increased. No oscillatory structure was observed in the field-dependence of the total absorption. (auth)

11085 Helium migration in borogermanate glasses. Shelby, J.E. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.*; **46**: No. 10, 4510-4514(Oct 1975).

Helium permeation, diffusion, and solubility were measured in a series of B_2O_3—GeO_2 glasses. All three parameters exhibit negative deviations from additivity at all compositions. Since intermediate glasses in this series also always have a lower free volume than would be predicted from additivity, it is postulated that the deviations observed in the helium mobility and solubility are primarily due to an increase in the compactness of the glass network. This conclusion is consistent with the results of several other recent studies of gas mobility in glass. (auth)

11086 Neutron-diffraction study of UO_2: Paramagnetic state. Lander, G.H.; Faber, J. Jr.; Freeman, A.J.; Desclaux, J.P. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., B;* **13**: No. 3, 1177-1182(1 Feb 1976).

The magnetic form factor of the induced moment in UO_2 has been measured in the paramagnetic state at $T = 65°K$ with polarized neutrons in an applied field of 50 kOe. The theoretical form factor is derived with the tensor-operator method and the $< j/subi/ >$ integrals for U^{4+} derived from relativistic Dirac-Fock wave functions. Three models for the electronic state are considered: (i) the free-ion U^{4+} ground state, (ii) the $^3H_4$ Γ_5 crystal-field ground state, and (iii) the Rahman and Runciman mixed-J Γ_5 ground state. The calculation of the magnetic scattering in the presence of intermediate coupling and J mixing is discussed. Whereas the experimental data are unable to distinguish between the small angular differences predicted for the three models, the radial dependence of the magnetic scattering is found to be in good agreement with theory and confirms the validity of the Dirac-Fock $< j/subi/ >$ integrals. (AIP)

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 10473, 10498, 10541

11087 (CONF-760209—9) **Deuteron and helium ion irradiation of ceramic coatings on Nb—1% Zr.** Rossing, T.D.; Kaminsky, M.; Das, S.K. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 14p. Dep. NTIS $3.50.

From 2. international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America &USA& (16 Feb 1976).

The surface damage to insulating barium alumino-silicate glass coatings due to irradiation by 100 and 250 keV deuterons and helium ions at room temperature and at 300°C has been studied. Blisters are observed after irradiation at room temperature with both deuterons and helium ions with energies of 100 and 250 keV. For deuteron irradiation a large fraction of the blisters have diameters which are approximately 3 to 5 times larger than the diameter observed with helium ions for identical irradiation conditions, but the density of blisters is nearly an order of magnitude lower. For irradiation at 300°C, no blisters are observed with either type of particle. The sharp rise in permeation rate with temperature is thought to be responsible for this behavior. The blister skin thicknesses have been measured and correlated with calculated projected-range values.

11088 **Electron-nuclear double-resonance investigations of V/sub OD/ centers in CaO.** Abraham, M.M. (Oak Ridge National Lab., TN); Chen, Y.; Unruh, W.P. *Phys. Rev., B;* **12**: No. 11, 4766-4770(1 Dec 1975).

Single crystals of CaO doped with deuterium have been grown by the submerged-arc-fusion method and V/sub OD/ centers were produced by γ irradiation at 77°K. EPR and electron-nuclear double-resonance measurements yield the following spin Hamiltonian parameters: g/sub parallel/ = 2.0020(2), g/sub perpendicular/ = 2.0730(2), A/sub parallel/ = +0.423(1) MHz, A/sub perpendicular/ = -0.212(1) MHz, and P = +0.188(1) MHz. Relative signs were obtained experimentally and the assignment of the absolute signs follows from the assumption of a positive dipolar interaction of the hole with the reported positive deuterium nuclear moment. The magnetic hyperfine interaction is essentially all dipolar and implies a slight outward (100) relaxation of the axial oxygens. The measured electric field gradient at the deuteron is compared with the corresponding case in MgO and with other substitutional-impurity trapped-hole centers in the cubic oxides. (auth)

COMPOSITE MATERIALS

REFER ALSO TO CITATION(S) 10959

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 10967

11089 **Method for preparing boron-carbide articles.** Benton, S.T.; Masters, D.R. (to U.S. Energy Research and Development Administration). US Patent 3,914,371. 21 Oct 1975. Filed date 27 Dec 1973. 4p.

PAT-APPL-428,927.

The invention is directed to the preparation of boron carbide articles of various configurations. A stoichiometric mixture of particulate boron and carbon is confined in a suitable mold, heated to a temperature in the range of about 1250 to 1500°C for effecting a solid state diffusion reaction between the boron and carbon for forming the boron carbide (B_4C), and thereafter the resulting boron-carbide particles are hot-pressed at a temperature in the range of about 1800 to 2200°C and a pressure in the range of about 1000 to 4000 psi for densifying and sintering the boron carbide into the desired article.

11090 **Method and apparatus for fabricating a composite structure consisting of a filamentary material in a metal matrix.** Banker, J.G.; Anderson, R.C. (to U.S. Energy Research and Development Administration). US Patent 3,913,657. 21 Oct 1975. Filed date 17 Jul 1974. 8p.

PAT-APPL-489,215.

A method and apparatus are provided for preparing a composite structure consisting of filamentary material within a metal matrix. The method is practiced by the steps of confining the metal for forming the matrix in a first chamber, heating the confined metal to a temperature adequate to effect melting thereof, introducing a stream of inert gas into the chamber for pressurizing the atmosphere in the chamber to a pressure greater than atmospheric pressure, confining the filamentary material in a second chamber, heating the confined filamentary material to a temperature less than the melting temperature of the metal, evacuating the second chamber to provide an atmosphere therein at a pressure, placing the second chamber in registry with the first chamber to provide for the forced flow of the molten metal into the second chamber to effect infiltration of the filamentary material with the molten metal, and thereafter cooling the metal infiltrated-filamentary material to form said composite structure.

11091 **Apparatus for fabricating composite ceramic members.** Roy, P.; Simpson, J.L.; Aitken, E.A. (to U.S. Energy Research and Development Administration). US Patent 3,915,119. 28 Oct 1975. Filed date 7 May 1974. 6p.

PAT-APPL-467,684.

Methods and apparatus for fabrication of composite ceramic members having particular application for measuring oxygen activities in liquid sodium are described. The method involves the simultaneous deposition of ThO_2: 15 percent Y_2O_3 on a sintered stabilized zirconia member by decomposition of gaseous $ThCl_4$ and YCl_3 and by reacting with oxygen gas. Means are provided for establishing an electrical potential gradient across the zirconia member whereby oxygen ions, from a source on one side of the member portion to be coated, are migrated to the opposite side where a reaction and said decomposition and deposition are effected.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 10676, 11094

11092 **Strength and fracture in glass matrix composites.** Biswas, D.R.; Fulrath, R.M. (Univ. of California, Berkeley). *J. Am. Ceram. Soc.;* **58**: No. 11-12, 526-527(1975).

The uniaxial bend strength and fracture initiation energy of glass matrix composites containing nonspherical Al_2O_3 and spherical W particles were measured. Results show that, although the strength is increased by incorporation of 47.4 vol percent W, the fracture initiation energy was nearly the same as that for glass. (JRD)

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 10925

RADIATION EFFECTS

11093 (AD/A—007670) **Radiation induced electrical current and voltage in dielectric structures. Physical sciences research papers.** Frederickson, A.R. (Air Force Cambridge Research Labs., L.G. Hanscom Field, Mass. (USA)). 22 Nov 1974. 41p. (AFCRL-TR—74-0582; AFCRL-PSRP—613). NTIS $3.75.

A computational technique has been developed in one dimension for prediction of radiation-induced electrical currents and electrostatic fields in metal-dielectric slab structures. High energy radiation transport effects produce divergent electron currents, time-dependent electrostatic fields, and time-dependent conduction electron currents. These effects are considered and the computational technique predicts electric fields approaching breakdown intensity and time-dependent electrode currents which may even change sign. Brief comments on application of the technique to field effect electronic devices are included. Results are given for several metal-dielectric slab combinations under 200 keV and 1.25 MeV photon irradiations. (GRA)

POLYMERS AND PLASTICS

REFER ALSO TO CITATION(S) 10959

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 10967

MECHANICAL PROPERTIES

11094 **Characterization of a polyimide matrix for fiber composites.** Penn, L.S.; Mones, E.T.; Chiao, T.T. (Univ. of California, Livermore). Contract W-7405-Eng-48. *SAMPE Q.;* 7: No. 2, 30-38(Jan 1976).

The properties of the uncured and cured polyimide resin Hexcel Products, Inc. F-178 were determined. The uncured resin, a gummy paste, is a mixture of several components, containing imide groups, olefin groups, and free amine groups. There is very

little variation in the resin from batch to batch and, if properly stored, it is chemically stable over time. The cast resin, cured for 1 h at 130°C, 1 h at 180°C, and 24h at 232°C, has a tensile strength of 51.8 MPa (modulus, 4143 MPa) at room temperature, decreasing to a fourth of the room temperature value at 180°C. The cured resin has a flexural strength of 111 MPa (modulus, 3820 MPa) at room temperature and 30.8 MPa (modulus, 1740 MPa) at 232°C. Aging by heat and aircraft fluids causes little change in flexural strength, but exposure to water reduces the high temperature flexural strength by 76 percent. Since the resin was formulated especially for use at high temperature as a matrix material in fiber composites, further work is recommended to correlate neat resin behavior with composite behavior. (auth)

OTHER MATERIALS

REFER ALSO TO CITATION(S) 10527, 10959

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 10351

11095 (RFP-Trans—178) **Method for making a silicic acid coating film.** Nagasao, T.; Tanaka, M. 17 May 1967. Translation of Japanese Patent 474,464. 3p. Dep. NTIS $3.50.

A method for making waterproof silicic acid films is described. A silicate solution overlayed on the substrate is hardened by baking and then dipped in aqueous HCl or NH_4Cl solution followed by treatment with aqueous boric acid or sodium borate solution. (JRD)

11096 **High temperature insulating carbonaceous material.** Klett, R.D. (to U.S. Energy Research and Development Administration). US Patent 3,914,392. 21 Oct 1975. Filed date 27 Mar 1973. 8p.

PAT-APPL-345,422.

High-temperature insulating bodies are made by granulating cork, compressing and heating to bind and cure the cork granules, and thereafter carbonizing the bound and cured granules. The carbonized material, if desired, may be graphitized.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 10983, 12093

11097 **Pressure and temperature dependence of electronic energy levels in PbSe and PbTe.** Schluter, M.; Martinez, G.; Cohen, M.L. (Univ. of California, Berkeley). *Phys. Rev., B;* **12**: No. 2, 650-658(15 Jul 1975).

Using recent highly accurate pseudopotential band structures of PbSe and PbTe, the variation of the smallest gap at L with hydrostatic pressure and with temperature was calculated. The experimental values of the pressure coefficient can well be reproduced assuming reasonable slopes of the pseudopotential-form-factor curves. Combining these values with experimental compressibility and thermal-expansion coefficients, the anharmonic part of the temperature coefficient has been evaluated and found to contribute about 50 percent to the total experimental temperature coefficient. The remaining contribution arising from electron-phonon interactions has been analyzed using Brooks—Yu and Fan-like scattering theory. While the inclusion of a Debye—Waller factor yields reasonable results for the L gap in PbTe, it fails for the Σ-L gap and it predicts a temperature coefficient of the opposite sign for PbSe. A detailed analysis of the PbSe discrepancy is presented. It is proposed that Fan-type intravalley and intervalley scattering can resolve the dilemma. First-order estimates for Fan-type scattering contributions are presented. (auth)

11098 **Lattice dynamics of hexagonal MoS_2 studied by neutron scattering.** Wakabayashi, N.; Smith, H.G.; Nicklow, R.M. (Oak Ridge National Lab., TN). *Phys. Rev., B;* **12**: No. 2, 659-663(15 Jul 1975).

Phonon-dispersion curves for the hexagonal-layered compound MoS_2 were measured at room temperature by inelastic-neutron-scattering techniqes for the [100] and [001] directions. Results were analyzed on the basis of a model which includes valence forces between atoms in a layer and axially symmetric forces between atoms in neighboring layers. While the model reproduces the essential overall features of the data, the present analysis indicates the need for a more sophisticated treatment of valence forces and/or for the inclusion of the atomic polarizabilities. The temperature dependence of the specific heat and the Debye temperature were calculated from the model. (auth)

11099 **Librational motion of the H /sub lambda/(Li^+) center in KCl.** Schoemaker, D. (Argonne National Lab., IL). *Phys. Rev., B;* **12**: No. 2, 715-717(15 Jul 1975).

It is shown from the analysis of some subtle features of the ESR spectra that the Cl_2^- axis of the H/sub A/(Li^+) center in the KCl:Li^+, which makes a 26° angle with a [100] direction, does not lie exactly in a (110) plane at 4.2°K, but lies outside it by about 1.5°. Such a geometry implies the existence of a librational motion over a 3° angle. The behavior of the ESR lines both as a function of temperature and under [110] uniaxial stress indicates that such a motion exists, and that it is very likely a tunneling motion at 4.2°K with a rate of about 1 x 10^7 Hz. (auth)

11100 **Moessbauer spectra of iron—chromium sulphospinals with varying metal ratio.** Lotgering, F.K.; van Diepen, A.M.; Olijhoek, J.F. (Natuvrkundig Lab., Eindhoven, Netherlands). *Solid State Commun.;* **17**: No. 9, 1149-1153(1 Nov 1975).

Samples of the sulfospinel $FeCr_2S_4$ with varying Fe/Cr ratio around the nominal composition have been investigated by Moessbauer spectroscopy. The spectra with the narrowest lines, as well as a λ-type peak in the specific heat-temperature curve at the low temperature transition previously described, were obtained for an overall composition with a small Fe deficit. The broadening often observed in Moessbauer spectra of $FeCr_2S_4$ samples is attributed to Fe^{2+} on octahedral sites in the spinel phase, resulting in an electric field gradient at the Fe^{2+} ions on the tetrahedral sites. The paramagnetic Moessbauer spectrum of Fe/sub 1.06/Cr/sub 1.94/S_4 is in accordance with this interpretation. (auth)

11101 **Disorder and ionic polarons in solid electrolytes.** Pardee, W.J.; Mahan, G.D. (Univ. of Indiana, Bloomington). *J. Solid State Chem.;* **15**: No. 4, 310-324(Dec 1975).

The role of ion-ion repulsion and ion-phonon coupling in superionic conduction is explored. It is argued that the order-disorder phase transition is not associated with the conductivity discontinuity, but with a higher temperature second order phase transition which has been seen in some superionic conductors and which is predicted for others. The specific heat, ion distribution, and conductivity are calculated.

PROPERTIES

REFER ALSO TO CITATION(S) 11015, 11016, 12095

11102 (CEA-N—1817(Suppl.), pp 28) **Magnetic properties of manganese acetate.** Burlet, P.; Burlet, P.; Bertaut, E.F. 1975.

In Grenoble Fundamental Research Department. Supplement to semi-annual bulletin no.7, January-June 1975. ILL experiments.

Neutron diffraction study of manganese acetate $Mn(CH_3COO)_2 2D$ in the temperature range 1.6 to 4.2°K, and an applied field up to 15 kOe shows a metamagnetic transition of second order. (FR)

11103 (CEA-N—1817(Suppl.), pp 20-26) **Refinement in YIG yttrium garnet structure. A case of strong extinction and absorption.** Bonnet, M.; Delapalme, A.; Fuess, H.; Thomas, M. 1975. (In French).

In Grenoble Fundamental Research Department. Supplement to semi-annual bulletin no.7, January-June 1975. ILL experiments.

X-ray diffraction study of (YIG) yttrium garnet structure, with a monocrystalline sphere, showed important extinction and absorption effects. The Darwin real crystal model ("mosaics crystal") is proposed for deriving the extinction correction. Results obtained from defining thermal vibration and extinction parameters are shown. (FR)

11104 (UCID—15850) **High pressure mechanical properties of Tugboat coral.** Stephens, D.R.; Heard, H.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 May 1971. Contract W-7405-Eng-48. 11p. Dep. NTIS $3.50.

Project Tugboat is a chemical explosive excavation experiment designed to (1) provide a light draft boat harbor at Kawaihae Bay, Hawaii, (2) test the applicability of cratering for harbor construction, and (3) provide technical data useful for the design of nuclear harbor excavation experiments. Mechanical properties of the coral-sea water detonation medium was studied in order that calculations could be made of the phenomenology of the event. (DLC)

11105 **Measurements of heat capacity, electrical resistivity and hemispherical total emittance of two grades of graphite in the range 1,500 to 3,000°K by a pulse heating technique.** Cezairliyan, A.; Righini, F. (National Bureau of Standards, Washington, D.C. (USA)). *Rev. Int. Hautes Temp. Refract.;* **12**: No. 2, 124-131(Apr 1975).

From 4. European Conference on thermophysical properties of solids at high temperatures; Orleans, France (4 Sep 1974).

Measurements of heat capacity, electrical resistivity and hemispherical total emittance of Poco and pyrolytic graphites in the temperature range 1,500 to 3,000°K by a subsecond duration pulse heating technique are described. For a given graphite grade, heat capacities of different specimens were in agreement within 0.5 percent. The difference between the results of the two different grades was about 1.8 percent: the results of Poco being higher than those of pyrolytic. Electrical resistivity of the Poco graphite was about four times greater than that of pyrolytic graphite (parallel to basal planes). Hemispherical total emittance of Poco graphite was almost twice that of pyrolytic graphite. (FR)

11106 Effect of heterovalent impurities codiffusing with monovalent tracers in ionic crystals. Mitchell, J.L.; Lazarus, D. (Univ. of Illinois, Urbana). *Phys. Rev., B;* 12: No. 2, 734-752(15 Jul 1975).

Tracer-diffusion measurements were made for ^{45}Ca and ^{22}Na codiffusing into pure NaCl as a function of temperature, initial calcium concentration, and diffusion anneal time. The measured penetration profiles deviate markedly from the Gaussian dependence expected for diffusion from a thin source. The curvature is caused by each divalent Ca ion introducing an extra "extrinsic" vacancy into the diffusion zone in order to maintain charge neutrality. In such cases, the limiting slope was shown not to be a valid measure of the tracer diffusivity. Computer fits were generated by a model which corrects for the effect and is found to give excellent agreement with the data except for the most extreme cases. The model can find the initial concentration of the impurity and the diffusivity of the impurity within a factor of 2 from the penetration profile for the monovalent tracer. The effect enters to first order into the measurement of the isotope effect in ionic crystals and can result in major errors in the measured isotope effect for even small deviations from a Gaussian profile. The diffusion coefficients for ^{22}Na diffusing in NaCl over the temperature range of (575-775)°C are given by D/sub Na/ = 73 exp(-2.04 +- 0.02 eV/kT)cm²/s, and for ^{45}Ca, D/sub Ca/ = 0.23 exp(-1.61 +- 0.03 eV/kT)cm²/s. 14 fig, 6 tables (auth)

11107 Ionic conductivity in $LiAlSiO_4$. Johnson, R.T. Jr.; Morosin, B.; Knotek, M.L.; Biefeld, R.M. (Sandia Labs., Albuquerque, NM). *Phys. Lett., A;* 54: No. 5, 403-404(6 Oct 1975).

$LiAlSiO_4$ materials are shown to be good lithium ion conductors at high temperatures (approximately 600°C). The ionic conductivity in the glass phase is greater than that of the glass—ceramic (β-eucryptite), and a lower lithium content appears to reduce the conductivity. (auth)

11108 Codeposited pyrocarbon-silicon carbide coatings for nuclear fuel particles. Kaae, J.L.; Reynolds, G.H. (General Atomic Co., San Diego, Calif. (USA)). *J. Nucl. Mater.;* 58: No. 2, 237-240(Nov 1975).

Mixed coatings for fertile fuel particles are currently undergoing extensive evaluation and testing to determine if the potential advantages of the mixed pyrocarbon-silicon carbide coatings can be realized in practice. (NL)

11109 Spin dynamics and critical fluctuations in a two-dimensional random antiferromagnet. Als-Nielsen, J. (Brookhaven National Lab., Upton, NY); Birgeneau, R.J.; Guggenheim, H.J.; Shirane, G. *Phys. Rev., B;* 12: No. 11, 4963-4979(1 Dec 1975).

A comprehensive elastic- and inelastic-neutron-scattering study of the binary mixed antiferromagnet $Rb_2Mn_{0.3}Ni_{0.7}F_4$ was carried out. The pure materials Rb_2MnF_4 and Rb_2NiF_4 are [2d] near-Heisenberg antiferromagnets of the K_2NiF_4 type. Elastic-scattering experiments demonstrate that the Mn^{2+} and Ni^{2+} ions are randomly distributed on a plane square lattice. At approx. 64°K, the system undergoes a second-order phase transition to two distinct [3d] antiferromagnetic structures, with both structures being composed of simple [2d] square antiferromagnetic arrays. All properties are found to be determined by the intraplanar interactions alone. Inelastic measurements show that at low temperatures the spin dynamics of this binary random alloy are characterized by two well-defined bands of excitations. The widths and energies of the zone-boundary modes are accurately predicted using a simple Ising cluster model while the over-all dispersion is correctly given by the Walker mean-crystal model. The above calculations involve only interaction constants taken from the pure materials and J/sub Mn-Ni/ = (J/sub Mn-Mn/J/sub Ni-Ni/)$^{1/2}$ so that there are no adjustable parameters. At higher temperatures it is found that the gap at q = 0 renormalizes like the sublattice magnetization while the excitations at larger wave vectors remain well defined through T/sub N/ and only slightly renormalized from their T = 0 energies. Critical scattering measurements of the staggered susceptibility and the correlation length were carried out between 69 and 120°K; it is found that over this temperature range they exhibit approximate power-law divergences with exponents close to those of the [2d]-Ising model. 19 fig (auth)

11110 Magnetic ordering in $CsCoBr_3$. Yelon, W.B. (Institut Laue-Langevin, Grenoble, France); Cox, D.E.; Eibschutz, M. *Phys. Rev., B;* 12: No. 11, 5007-5015(1 Dec 1975).

The magnetic ordering in $CsCoBr_3$ was studied by neutron diffraction, on both powder and single-crystal specimens, and by specific-heat and magnetic-susceptibility measurements. This compound has the hexagonal $CsNiCl_3$ type of structure, and the susceptibility shows characteristic one-dimensional behavior, while the specific heat indicates that three-dimensional ordering occurs at about 28°K. The neutron single-crystal study shows that between T/sub N/ and 14°K the magnetic structure is consistent with the orthorhombic space group $Cmc2_1$, with one-third of the antiferromagnetic cobalt chain being disordered and the other two-thirds antiferromagnetically coupled in the base plane. Between 4 and 10°K the structure may be described by the space group $Cm'c2_1'$, and is similar to the colinear arrangement reported for $CsCoCl_3$ and $RbCoBr_3$ but with a small canting of about 10°. The transformation from one structure to the other in the region of 10-14°K can be explained equally well by either the formation of an intermediate phase of lower symmetry or by a discontinuous process in which the two phases coexist. The powder data reveal a small amount of a second low-temperature phase compatible with the space C/sub p/m'c2$_1$', consistent with negative rather than positive next-nearest-neighbor interactions in the basal plane. 11 fig, 4 tables (auth)

11111 Self-consistent pseudopotential method for localized configurations: molecules. Cohen, M.L.; Schlueter, M.; Chelikowsky, J.R.; Louie, S.G. (Univ. of California, Berkeley). *Phys. Rev., B;* 12: No. 12, 5575-5579(15 Dec 1975).

A method is proposed using pseudopotentials in a self-consistent manner to describe localized configurations such as molecules, surfaces, impurities, vacancies, finite chains of atoms, adsorbates, and solid interfaces. Specific application is made to the Si_2 molecule. The Si_2 energy levels and charge densities are calculated with reasonable accuracy using a plane-wave basis set. (auth)

11112 Time-dependent behavior in electron-hole condensation. Silver, R.N. (Los Alamos Scientific Lab., NM). *Phys. Rev., B;* 12: No. 12, 5689-5697(15 Dec 1975).

The dominant relaxation rates in electron-hole condensation are calculated from the stochastic rate equations proposed in a previous paper. These govern the time scale for the nucleation of electron-hole droplets and for fluctuations in the number of electron-hole pairs bound to a nucleation center. The calculational procedure makes use of exact recursion relations for the temporal moments of the probability distribution. It is found that metastable states of electrons and holes can exist at high temperatures (T greater than or equal to 2°K in Ge), for a limited range of exciton densities. At low temperatures the finite carrier lifetimes lead to measureably short relaxation times. The importance of the time dependence of the exciton density in experiments at fixed generation rates is stressed. Some of the reported discrepancy between spectroscopic and thermodynamic values of the work function may be ascribed to supersaturation effects. (auth)

11113 Ultraviolet photoelectron spectra of cesium halides. Smith, J.A.; Pong, W. (Univ. of Hawaii, Honolulu). *Phys. Rev., B;* 12: No. 12, 5931-5936(15 Dec 1975).

Energy distributions of photoelectrons from evaporated films of cesium halides were measured at photon energies of 11 to 23 eV. The photoelectron spectra show structures that can be identified as relatively high densities of states in the Cs^+ 5p core as well as in the valence and conduction bands. Doublet core states due to spin-orbit splitting are observed for all the cesium halides. The bandwidths of these states are 3.1 +- 0.3 eV for CsCl, CsBr, CsI, and 4.0 +- 0.3 eV for CsF. The valence-band widths for CsCl, CsBr, CsI, and CsF are found to be 1.8 +- 0.3, 2.1 +- 0.3, 2.4 +- 0.3, and 1.7 +- 0.3 eV, respectively. The energy distribution curves of CsBr indicate a valence-band splitting of 0.5 +- 0.2 Ev, which is consistent with the spin-orbit splitting of the Br (4p) atomic state. The photoelectron spectra also show the triplet structure associated with the excitation from the I^- 5p band of CsI as reported recently by DiStefano and Spicer. Some evidence of core-exciton decay can be seen in the spectra of CsCl. The photoemission results are used to estimate the binding energies of the Γ core excitons of cesium halides. (auth)

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 10497, 10498, 11191

11114 (AD/A—006679) Transient radiation-effects tests of a Corning radiation-resistant optical fiber. Physical science research

papers. Wall, J.A. (Air Force Cambridge Research Labs., L.G. Hanscom Field, Mass. (USA)). 6 Jan 1975. 20p. (AFCRL-PSRP—622; AFCRL-TR—75-0012). NTIS $3.25.

Semi-transient and transient radiation-effects tests were performed on a Corning low-loss, radiation-resistant optical fiber. The semi-transient tests, which involved measurement of the fiber transmission during and after irradiation with x-rays, show this fiber to be much more resistant to permanent damage by radiation than other available glass fibers. The transient radiation-effects tests, in which the response of the fiber was measured during and for short times after pulses of x rays and neutrons, show that the fiber may not be applicable to systems that cannot tolerate operational lapses of a few microseconds duration. This is because the fiber emits fluorescent radiation and shows temporary transmission losses during and shortly after pulses of radiation. (GRA)

11115 (AD/A—008050) **Study of the effects of radiation on the electrical and optical properties of HgCdTe.** Mallon, C.E.; Green, B.A.; Leadon, R.E.; Naber, J.A. (Intelcom Rad Tech, San Diego, Calif. (USA)). 31 Dec 1974. Contract F19628-72-C-0311. 52p. (INTEL-RT—8027-012). NTIS $4.25.

See also report dated 30 Jun 1974, AD/A—003390.

Results are presented of experimental and theoretical investigations of the effects of electron, neutron, and gamma irradiation on the optical and electrical properties of the alloy semiconductor HgCdTe. These effects are of major interest in this program, since this data can be used to predict the radiation response of devices fabricated from HgCdTe. Section 2 discusses experimental methods used in this effort. The results of a 10K neutron irradiation of an n-type sample, QM 48-19, are presented. Changes in lifetime, carrier density, Hall mobility, and conductivity at 80K were studied as a function of electron energy between 2 and 30 MeV. Preirradiation temperature dependence measurements of carrier density, Hall mobility, conductivity, and steady-state photoconductivity of a p-type HgCdTe sample, QM 1, are presented. This sample was irradiated at 80K with 5-MeV electrons, which resulted in type conversion from p-type to n-type. The final section presents mobility and lifetime analysis and correlates the effects observed for neutron, gamma, and electron irradiations. (GRA)

11116 (AD/A—008177) **Thermal neutron radiation effects in II-VI compounds. Final technical report, 1 Nov 1971-1 Nov 1973.** Kikuchi, C.; Huang, C. (Michigan Univ., Ann Arbor (USA)). Nov 1974. Contract F33615-72-C-1189. 45p. NTIS $3.75.

The double acceptor center in neutron-irradiated CdTe was studied. The variation of resistivity as a function of time was measured. Analysis of experimental results suggests that (a) the double acceptor center includes Te-vacancy, (b) the height of the barrier is about 0.25 eV, (c) the effective range of the potential barrier is about 200 A, and (d) the activation energy of motion of interstitial cadmium is estimated to be 0.74 eV. (GRA)

11117 (CONF-760209—8) **Investigations of radiative electron capture by ion channeling techniques.** Appleton, B.R.; Ritchie, R.H.; Biggerstaff, J.A.; Noggle, T.S.; Datz, S.; Moak, C.D.; Verbeek, H. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. 22p. Dep. NTIS $3.50.

From 2. international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America ⁸USA⁹ (16 Feb 1976).

The unique constraints imposed on the interactions of energetic heavy ions as a result of the channeling effect are utilized to investigate the phenomenon of radiative electron capture (REC) for 17 to 40 MeV oxygen ions. Measured cross-sections and widths of the REC radiation are compared with calculations made specifically for the channeling situation.

11118 (LBL—2728) **Electron microscopy studies of ion implanted silicon.** Seshan, K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-eng-48. 108p. Dep. NTIS $5.50.

Thesis.

The nature of defects resulting from the implantation of phosphorous ions into doped silicon and a model of how they form are reported. This involved an electron microscope study of the crystallographic defects (in the 300A size range in concentration of $10^{15}/cm^3$) that form upon annealing. Images formed by these crystallographic defects are complex and that nonconventional imaging techniques are required for their characterization. The images of these small defects (about 300A) are sensitive to various parameters, such as foil thickness, their position in the foil, and diffracting conditions. The defects were found to be mostly interstitial hexagonal Frank loops lying on the four [111] planes and a few perfect interstitial loops; these loops occurred in concentrations of about $10^{16}/cm^3$. In addition, "rod like" linear defects that are shown to be interstitial are also found in concentrations of $10^{15}/cm^3$. It was found that the linear defects require boron for their formation. A model is proposed to account for the interstitial defects. The number of point defects that make up the defects is of the same order as the number of implanted ions. The model predicts that only interstitial loops ought to be observed in agreement with several recent investigations. Dislocation models of the loops are examined and it is shown that phosphorous ions could segregate to the Frank loops, changing their displacement vectors to a/x[111]. (x greater than 3) thus explaining the contrast effects observed. It would also explain the relative electrical inactivity of P^+ ion implants. (DLC)

11119 (AD/A—006516) **The occurrence of anomalously low friction during electron bombardment of a sliding molybdenum disulphide surface.** Dukhovskoi, E.A.; Ponomarev, A.N.; Silin, A.A.; Talroze, V.L. Translated by G.H. Kinner from *Zh. Eksp. Teor. Fiz.*; 4: No. 20, 268-272(1974). 9p. (RAE-Lib-Trans—1829). NTIS $3.25.

Experimental data are given describing the occurrence of anomalously low friction when a sliding surface of molybdenum disulfide is irradiated with electrons. Indication is made of the mechanism and similarity of the effects when molybdenum disulfide is bombarded either by electrons or accelerated helium atoms. (GRA)

11120 Near-surface nucleation and crystallization of an ion-implanted lithia-alumina-silica glass. Arnold, G.W. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.*; 46: No. 10, 4466-4473(Oct 1975).

Surface crystallization of a Au^+-ion-implanted lithia-alumina-silica glass was realized. Annealing of a glass sample implanted with 285-keV Au^+ ions at 550°C results in the growth of colloidal Au particles of 18 to 35-A radius. The Au particles constitute sites for the precipitation of lithium metasilicate crystals at 550°C. Further annealing at 750°C allows the growth of quartz and β-spodumene crystals. The crystallized surface obtained after the high-temperature anneal was characterized by a Knoop microhardness number of 626, which is of the order of that obtained for commercial volume-crystallized glass-ceramics of similar composition. (auth)

11121 Infrared reflection and Raman scattering of ion-implanted nitrogen in gallium phosphide. Kachare, A.H.; Cherlow, J.M.; Yang, T.T.; Spitzer, W.G.; Euler, F.K. (Departments of Electrical Engineering and Physics, University of Southern California, Los Angeles, California 90007). *J. Appl. Phys.*; 47: No. 1, 161-173(Jan 1976).

Infrared reflection and Raman scattering measurements were performed on a set of GaP samples implanted at room temperature with $^{14}N^+$ and $^{15}N^+$ ions with an energy of 3 MeV and fluences in the range of $5x10^{15}$—$2x10^{17}$ ions/cm². The reflection data for all but the most heavily implanted samples were fitted with a classical dispersion layer model. Some of the parameters used in this model were obtained from the Raman data. An increased in the damping constant γ is the largest implantation-induced change in the dispersion parameters. Annealing studies were performed on several samples implanted with $2x10^{17}$ ions/cm². Raman and x-ray measurements indicated that samples annealed at 773 degreeK recrystallized in a polycrystalline fashion but those annealed at 573 degreeK became single crystals. After both types of annealing procedure, structure resulting from the nitrogen localized vibrational mode was seen in the reflection spectra. This mode exhibited the expected isotope shift, appearing at ~495 cm^{-1} for samples implanted with $^{14}N^+$ and ~480 cm^{-1} for samples implanted with $^{15}N^+$. That the mode was observable only after annealing indicated that there was some reduction of the short-range order in the unannealed samples. The results are discussed in terms of prevalent models for lattice disorder introduced by ion implantation. (AIP)

CHEMISTRY

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 10527, 11091, 12314

11122 (LA—1018(Vol.8)) **Chemistry of uranium and plutonium. Volume 8.** Kennedy, J. (ed.). (Los Alamos Scientific Lab., N.Mex. (USA)). 27 Jun 1947. 319p. Dep. NTIS $9.75.

Declassified 24 Jan 1973.

Chapter 8 contains analytical methods for U, Pu, and associated materials. Chapter 9 deals with control measures for radioactive hazards. (DLC)

11123 (UCID—15644-75-3) **General Chemistry Division quarterly report, July—September 1975.** Harrar, J.E. (comp. and ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Nov 1975. Contract W-7405-Eng-48. 59p. Dep. NTIS $5.45.

Analytical research and development for the Whitney Programs include the following studies: computer automation of the Cary Model 171 spectrophotometer; feasibility of a portable microwave-spectrometer analyzer for chemical contaminants in air; polarized x-ray source for energy-dispersive x-ray fluorescence spectrometry; lasers for analytical chemistry; ion-cyclotron-resonance mass spectrometer; time-resolved spectrophosphorimetry; x-ray photoelectron spectrometry (ESCA); automation of the Hewlett-Packard model 5950A ESCA spectrometer; system for determining tritium in solid materials; separation of molecular species by radiation pressure; examination of bulk versus surface decomposition in various TATB-binder formulations; study of a discolored TATB, utilizing ESCA spectrometry, scanning electron microscopy, and an electron microprobe; measurement of the detection limit for surface analysis by 1.5-MeV α-particle backscattering; curium spectroscopy; semimicrodetermination of hydroxyl and amino groups with pyromellitic dianhydride (PMDA); determination of microgram amounts of chloride by potentiometric titration; and, analysis of trace metals in water. Other studies include: laser spectroscopy of atomic uranium; simulation modeling of mixed-oxide fuel-rod fabrication plants; computation of simulated NMR spectra; chlorine-35 NMR studies of anion-binding sites in enzymes; automation of a mass spectrometer for the National Center for Toxicological Research (NCTR); and automation of the Davies-Gray/New Brunswick Laboratory Method for the determination of uranium. (JGB)

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 10286, 11375

11124 (AD/A—005218) **Computer programs for quantity determination in neutron activation analysis. Final report.** Antal, J.J.; Warnas, A.A. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Dec 1974. 72p. (AMMRC-TR—74-33). NTIS $4.25.

This report describes and lists several programs written in PAL III assembly language for the PDP-8 series of minicomputers to compute the quantity of an unknown element as determined by the AMMRC 14-MeV neutron activation analysis system. A complete determination of the error in the quantity of the unknown element is made in the program and is described here. (GRA)

11125 (BNWL-SA—5610) **Multielement characterization of atmospheric pollutants by x-ray fluorescence analysis and instrumental neutron activation analysis.** Rancitelli, L.A.; Tanner, T.M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1976. Contract E(45-1)-1830. 41p. (CONF-760311—2). Dep. NTIS $4.00.

From Symposium on the development of nuclear-based techniques; Vienna, Austria (15 Mar 1976).

The simultaneous measurement of a wide spectrum of elements in aerosols collected on air filters and in rainwater can yield information on the origin, transport, and removal of atmospheric pollutants. In order to determine the elemental content of these aerosols, a pair of highly sensitive, precise and complementing instrumental techniques, x-ray fluorescence and neutron activation analysis, have been developed and employed. Data are presented on the results of combined x-ray fluorescence and activation analysis of aerosols collected in a number of urban areas of the USA and from the 80th median sampling network in March 1972. From a comparison of these ratios in granite and diabase with those of filters placed in urban areas, it is evident that Zn, Se, Sb, Hg, and Pb levels have been increased by as much as several orders of magnitude. Al, Co, La, Fe, Eu, Sm, Tb, Ta, Hf, and Th appear to exist at levels compatible with an earth's crust origin. (auth)

11126 (CONF-751085—1) **Techniques for characterization of particulate matter: neutron activation analysis, x-ray photoelectron spectroscopy, scanning electron microscopy.** Hulett, L.D.; Dale, J.M.; Emery, J.F.; Lyon, W.S. Jr.; Fulkerson, W. (Oak Ridge National Lab., Tenn. (USA)). 1975. 17p. Dep. NTIS $3.50.

From EPRI workshop on sampling analysis and monitoring of stack emissions; Dallas, Texas, United States of America "USA" (2 Oct 1975).

Three techniques for particulate matter analysis are discussed: (1) neutron activation, which is a method that samples the entire specimen, both surface and bulk; (2) electron spectroscopy for chemical analysis (ESCA), which samples particle surfaces only; and (3) scanning electron microscopy (SEM), which reveals particle size and morphology, and can be used to determine composition differences in individual particles. These three techniques can be combined to construct highly detailed characterizations of particulate matter specimens. It is shown that multielement analysis can be quickly done by neutron activation and that surface analysis and individual particle analysis obtained by ESCA and SEM, are very important supplementary information. (auth)

11127 **Pathways of thirty-seven trace elements through coal-fired power plant.** Klein, D.H.; Andren, A.W.; Carter, J.A.; Emery, J.F.; Feldman, C.; Fulkerson, W.; Lyon, W.S.; Ogle, J.C.; Talmi, Y.; Van Hook, R.I.; Bolton, N. (Oak Ridge National Lab., TN). *Environ. Sci. Technol.*; 9: No. 10, 973-979(Oct 1975).

Coal, fly ash, slag, and combustion gases from a large cyclone-fed power plant 870 MW(e) were analyzed for a suite of elements. Mass balance calculations show that the sampling and analyses were generally adequate to describe the flows of these elements through the plant. Most Hg, some Se, and probably most Cl and Br were discharged to the atmosphere as gases. As, Cd, Cu, Ga, Mo, Pb, Sb, Se, and Zn were quite concentrated in fly ash compared to the slag, and were more concentrated in the ash discharged through the stack than in that collected by the precipitator. Al, Ba, Ca, Ce, Co, Eu, Fe, Hf, K, La, Mg, Mn, Rb, Sc, Si, Sm, Sr, Ta, Th, and Ti show little preferential partitioning between the slag and the collected or discharged fly ash. Cr, Sc, Na, Ni, U, and V exhibit behavior intermediate between the latter two groups. (auth)

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 11614, 11615, 11625

11128 (UCRL-Trans—10759) **Trace analysis by concentration on ion exchange papers, and x-radioisotopic fluorescence.** Robert, A.; Valles, R. Translated from *Radiochem. Radioanal. Lett.*; **15**: No. 4-5, 279-289(1973). 11p. Dep. NTIS $3.50.

The method of concentration on ion exchange resin-loaded paper is applied to the preparation of samples for x-ray radioactive fluorescence analysis. Examples are described for the elements Ca, Ba, Pb, and U in aqueous solution. Limits of detection for these elements and a practical method of preparation are about 10^{-1} ppM. (auth)

11129 **Liquid-chromatographic analysis for neutral carbohydrates in serum glycoproteins.** Mrochek, J.E. (Oak Ridge National Lab., TN); Dinsmore, S.R.; Waalkes, T.P. *Clin. Chem.*; **21**: No. 9, 1314-1322(1975).

We describe a sensitive, reproducible procedure of analysis for the six neutral carbohydrates in glycoproteins, by high-resolution anion-exchange chromatography. As many as 16 neutral carbohydrates can be separated by elution with a concentration gradient of boric acid (pH 7, 67 to 672 mmol/liter). The carbohydrates are detected with a cerate oxidimetric detector system, which monitors the fluorescence of Ce^{3+} produced by the reaction of the eluted constituents with Ce^{4+}. Sensitivity to 1 nmol of fucose is demonstrated. Analytical methods and results are presented for mannose, fucose, and galactose in serum glycoproteins of both normal women and those with metastatic breast cancer. We briefly discuss the possibility of separating and analyzing for the three neutral carbohydrates in serum glycoproteins in 4 h by isocratic (constant eluent concentration) elution from a chromatographic column. (auth)

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 10307, 11203, 11350, 11363, 11615

11130 (BNWL-SA—5480) **Recent experience in the analysis of postmortem samples for plutonium.** Thomas, V.W. Jr.; Kirby, L.J.; Nelson, I.C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 3 Sep 1975. Contract E(45-1)-1830. 21p. (CONF-751095—1). Dep. NTIS $4.50.

From 21. annual bioassay conference; San Francisco, California, United States of America "USA" (8 Oct 1975).

Procedures are described for isotopic analysis of large autopsy tissue samples for $^{239,240}Pu$ and ^{238}Pu at Hanford. Internal tracers (^{242}Pu, ^{236}Pu) are presently used to measure radiochemical recovery to an accuracy of +- 5 percent. Sample sizes may be up to at least 400g for soft tissues and up to 50g for bone with recoveries of 70 +- 30 percent. Some critical points of the procedure, problems and their solutions are discussed. (auth)

11131 (BNWL-SA—5594) **Radiochemical spectral analysis by maximum likelihood.** Nicholson, W.L.; Stevens, D.L. Jr. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 26p. (CONF-751113—9). Dep. NTIS $4.00.

From 1. ERDA statistical symposium; Los Alamos, New Mexico, USA (3 Nov 1975).

The radiochemical spectral analysis problem is expressed mathematically. Maximum likelihood estimates are derived for the two situations of standard spectra well-known and standard spectra imprecise. The maximum likelihood method is applied to backward-scattered alpha particle analysis of lunar soil samples from the Surveyor V moonlander. The standard spectra are assumed known. (JSR)

11132 (PB—240621) **Handbook of radiochemical analytical methods. Environmental monitoring series.** Johns, F.B. (National Environmental Research Center, Las Vegas, Nev. (USA)). Feb 1975. 149p. (EPA—680/4-75-001). NTIS $5.75.

This manual is a compilation of the chemical procedures used at the National Environmental Research Center-Las Vegas for determining stable elements and radionuclides in environmental surveillance samples. It supersedes "Southwestern Radiological Health Laboratory Handbook of Radiochemical Analytical Methods" published as Report No. SWRHL-11 in March 1970. It should be noted that the procedures in the current compilation are intended for use in processing relatively large numbers of samples in the shortest possible time for environmental radiological surveillance and, therefore, in some cases represent a compromise between precise analytical determination and adequate determination for surveillance purposes. For historical purposes, two methods for radiostrontium in milk are included since large numbers of samples were analyzed by these methods. An appendix provides instructions for preparing reagents listed for each method. It does not provide instructions for preparing solutions normally found in chemistry laboratories. (GRA)

11133 (SAND—75-8296) **Relation of iron, aluminum, and silicon layer thicknesses to the electron microprobe beam size.** Estill, W.B.; Smugeresky, J.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 23p. Dep. NTIS $3.50.

Nonconventional standards containing layers of known thicknesses of iron, aluminum, and silicon in a beryllium matrix were used to determine the effect of the size of a region enriched in these elements on the x-ray emission generated by an electron microprobe beam. These thicknesses were nominally 0.5, 1.0, 2.0, 5.0, and 10.0 μm and represent regions with dimensions of the order of the effective spot size. By analyzing these layers, calibration curves were generated to allow corrections to be made to standard intensities used for quantitative analyses in this size regime. As a result, a procedure was developed to allow a more accurate quantitative analysis of regions as small as 0.5 μm using characteristic x-ray emission. (auth)

11134 (UCLA—12-1047) **Determination of ^{238}Pu and ^{242}Cm in aqueous solid extracts.** Wood, R.A.; Nishita, H.; Hamilton, M.; Wakakuwa, S. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1976. Contract E(04-1)-GEN-12. 10p. Dep. NTIS $3.50.

A method is described for the quantitative determination of ^{238}Pu and ^{242}Cm contained in aqueous soil extracts. The organic matter is destroyed using standard wet ashing techniques. The 87.8-h ^{238}Pu and 163-d ^{242}Cm are isolated by co-extraction with iron and purified using cation exchange techniques. The final eluate is evaporated to dryness on stainless steel planchets and counted using an alpha spectrometer system in conjunction with a silicon surface barrier detector. Greater than 98 percent recovery of ^{238}Pu and ^{242}Cm was obtained from ammonium acetate and sodium hydroxide—nitric acid extracts of traced soil. The primary advantages of this method are: (1) secondary tracers are not needed for the determination of chemical yields, and (2) expensive and time-consuming electrodeposition techniques are not required for final sample mounting. (auth)

11135 (UCRL-Trans—10708) **Chemical identification and precise measurement of the tritium in a gaseous medium.** Dupuis, M.; Dupuis, M.C.; Charrier, G.; Colomer, J.; Humbert-Droz, C.; Lutz, M. Translated from *Bull. Inf. Sci. Tech. (Paris)*; No. 178, 27-45(Feb 1973). 44p. Dep. NTIS $4.00.

Several techniques were developed for the identification and precise measurement of tritium in a gas sample. For specific activities ranging from 10^{-6} to a few Ci/m^3, tritium in volatile form (hydrogen or light hydrocarbons) can be identified and measured by gas radiochromatography. For lower activities, down to 10^{-12} Ci/m^3, the following methods must be used: concentration (distillation, preparative gas chromatography, purification on uranium) of the sample with respect to the tritiated compounds (water, hydrogen, hydrocarbon); and, low-level measurements (liquid scintillation, ionization chamber, or proportional counter measurements). In a gaseous medium, and in particular in air, the tritium can appear in a number of different forms, such as water, hydrogen, or light hydrocarbons. According to the desired aim, it may be of interest to determine either the total tritium concentration within the specimen or the quantity of tritium in each individual compound. To arrive at these different objectives, a number of concentration and gas-purification units capable of treating up to several m^3 of air were developed, in order to separate the different tritiated species and to prepare them for radioactivity measurements which were made at the same time an object of study and of further development. The entire complex makes it possible to carry out precise measurements of the specific tritium activity in an interval ranging from 10^{-12} up to a few Ci per m^3 of gas. (auth)

11136 **Low level counting techniques.** Oeschger, H.; Wahlen, M. (Univ., Bern). *Annu. Rev. Nucl. Sci.*; **25**: 423-463(1975).

The most common detector systems are summarized and the parameters important to their application, such as sensitivity and background count rates are discussed. LLC techniques are also compared to other analytical procedures. A representative sample of the spectrum of applications of LLC in various scientific disciplines is given. Several typical LLC systems are reviewed, together with some of the results obtained. Finally, an overview is presented of future possibilities for applications of low level counting techniques. 6 tables, 1 figure, 80 references. (auth)

11137 **Loss of ^{32}P-phosphate and ^{14}C-carbonate activity during liquid scintillation counting of aqueous samples.** Weimer, W.C.; Rodel, M.G.; Armstrong, D.E. (Univ. of Wisconsin, Madison). *Environ. Sci. Technol.*; **9**: No. 10, 966-972(Oct 1975).

Loss of radioactivity in excess of natural decay was observed in aqueous samples of $^{32}P—PO_4^{-3}$ and $^{14}C—CO_3^{-2}$ counted by liquid scintillation in a dioxane-base counting solution. Loss of $^{32}P—PO_4^{-3}$ activity was increased by the presence of the HCO_3^- ion and ranged up to 23 percent in 8 hr and 46 percent in 4 days. Common solubilizing agents were ineffective in preventing $^{32}P—PO_4^{-3}$ loss and only partially effective in preventing $^{14}C—CO_3^{-2}$ loss. The $^{32}P—PO_4^{-3}$ activity was recovered by shaking and recounting the sample, but $^{14}C—CO_3^{-2}$ activity was incompletely recovered. Settling of insoluble materials within the counting solution apparently was responsible for $^{32}P—PO_4^{-3}$ activity loss. A dual mechanism of precipitation of $^{14}C—CO_3^{-2}$ and volatilization of $^{14}C—CO_2$ was responsible for ^{14}C loss. Acidification of the counting solution prevented $^{32}P—PO_4^{-3}$ activity loss; addition of phenethylamine to the counting solution prevented volatilization of $^{14}C—CO_2$, but no treatment was found to prohibit $^{14}C—CO_3^{-2}$ precipitation. (auth)

11138 **Determinations of oxide thicknesses on tritided erbium films using beta-induced x-ray fluorescence.** Musket, R.G.; Bauer, W. (Sandia Laboratories, Livermore, California 94550). *J. Appl. Phys.*; **47**: No. 1, 353-356(Jan 1976).

For a tritided erbium film, tritium-decay betas induce characteristic x-ray emission from the film, the Er_2O_3 oxide layer, and the substrate. Measurement of the beta-induced x-ray spectrum for x rays with energies between ~0.3 and 8 keV using a windowless Si(Li) detector permitted evaluation of the O(K/sub alpha/)/Er(L/sub alpha/) intensity ratio. This ratio was correlated with the total oxygen surface density as determined using proton-induced x rays from the same films, and the results have beeen compared to a theoretical model by Haggmark. A strong dependence of the O(K/sub alpha/)/Er(L/sub alpha/) ratio on Er_2O_3 areal density has been demonstrated for oxide thicknesses less than ~300 A. (AIP)

11139 **Beta-induced x rays from oxides on metal tritide films: A simple theoretical model.** Haggmark, L.G. (Sandia Laboratories, Livermore, California 94550). *J. Appl. Phys.*; **47**: No. 1, 357-361(Jan 1976).

A simple theoretical model has been developed to determine the intensity of the metal x rays emitted from metal tritides and also the intensity of the oxygen x rays from oxides that form on the surface of these tritides. This model includes the transport of the beta-decay electrons, the details of the x-ray production mechanisms, and the transport of the x rays out of the tritide films. It was found that for small surface oxide densities the ratio of the intensities of oxygen-to-metal x rays is a sensitive indication of the amount of surface oxide present. Reasonable comparisons were made with measured O(K/sub alpha/)/Er(L/sub alpha/) intensity ratios from Er(D,T). (AIP)

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 10244, 11125, 11126, 11127, 11390, 11397, 11399

11140 (IS—3558(Vol.1)) **Bibliography of mass spectroscopy literature for 1972 compiled by a computer method. Volume I. Bibliography and author index.** Capellen, J.; Svec, H.J.; Sage, C.R.; Sun, R. (comps.). (Ames Lab., Iowa (USA)). Aug 1975. Contract W-7405-eng-82. 499p. Dep. NTIS $13.50.

This report covers the year 1972, and lists approximately 10,000 articles of interest to mass spectroscopists. This two-volume report consists of three sections. Vol. I contains bibliography and author index sections. The bibliography section lists the authors, the title, and the publication data for each article. The author index lists the authors' names and the reference numbers of their articles. (auth)

11141 (LA—6091) **Automated spectrophotometer for plutonium and uranium determination.** Jackson, D.D.; Hodgkins, D.J.; Hollen, R.M.; Rein, J.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Sep 1975. Contract W-7405-Eng-36. 76p. Dep. NTIS $6.00.

The automated spectrophotometer described is the first in a planned series of automated instruments for determining plutonium and uranium in nuclear fuel cycle materials. It has a throughput rate of 5 min per sample and uses a highly specific method of analysis for these elements. The range of plutonium and uranium measured is 0.5 to 14 mg and 1 to 14 mg, respectively, in 0.5 ml or less of solution with an option to pre-evaporate larger volumes. The precision of the measurements is about 0.02 mg standard deviation over the range corresponding to about 2 rel percent at the 1-mg level and 0.2 rel percent at the 10-mg level. The method of analysis involves the extraction of tetrapropylammonium plutonyl and uranyl trinitrate complexes into 2-nitropropane and the measurement of the optical absorbances in the organic phase at unique peak wavelengths. Various aspects of the chemistry associated with the method are presented. The automated spectrophotometer features a turntable that rotates as many as 24 samples in tubes to a series of stations for the sequential chemical operations of reagent addition and phase mixing to effect extraction, and then to a station for the absorbance measurement. With this system, the complications of sample transfers and flow-through cells are avoided. The absorbance measurement system features highly stable interference filters and a microcomputer that controls the timing sequence and operation of the system components. Output is a paper tape printout of three numbers: a four-digit number proportional to the quantity of plutonium or uranium, a two-digit number that designates the position of the tube in the turntable, and a one-digit number that designates whether plutonium or uranium was determined. Details of the mechanical and electrical components of the instrument and of the hardware and software aspects of the computerized control system are provided.

11142 (PB—240764) **Simplified atomic absorption determination of stable strontium in milk and hay: a comparison of methods and stepwise procedure. Final report.** Barth, J.; Bruckner, B.H. (National Environmental Research Center, Las Vegas, Nev. (USA)). Feb 1974. 33p. (EPA—680/4-73-002). NTIS $3.75.

A highly simplified atomic absorption procedure for the determination of stable strontium in fluid milk, milk powder, and alfalfa is evaluated. A comparison is made between the atomic absorption method of additions and the standard curve method. A suggested stepwise procedure is given. (GRA)

11143 (SAND—75-8680) **Relative sputtering yields and quantitative surface analysis by Auger spectroscopy.** West, L.A. (Sandia Labs., Livermore, Calif. (USA)). Dec 1975. Contract AT(29-1)-789. 30p. (CONF-751023—5). Dep. NTIS $4.00.

From 22. national vacuum symposium; Philadelphia, Pennsylvania, USA (28 Oct 1975).

During the past few years, the qualitative analysis of surfaces by Auger electron spectroscopy has become an accepted analytical technique. With all analytical techniques, however, the ultimate goal is to obtain quantitative information. This paper presents data on the relative sputtering yield of several elements obtained by studying the surface composition of alloy systems (Cr-Pd, Ag-Pd, Cu-Pd, Mn-Ag-Pd and Nb-U) varying in composition from a few to roughly fifty atomic percent. The reported measurements were taken while sputtering after the alloy surface had reached a steady-state composition. Peak heights were referenced to in situ standards of the pure alloy components. Multiple determinations were carried out over a period of several weeks in order to check the reproducibility and to estimate the standard deviation in the data. This information was used to obtain uncertainty limits for the calculated sputtering yields. (auth)

11144 **Photoelectron spectroscopy.** Carlson, T.A. (Oak Ridge National Lab., TN). *Annu. Rev. Phys. Chem.*; **26**: 211-233(1975).

Photoelectron spectroscopy has established itself as one of the leading physical tools for the study of the electronic structure of molecules. Its contribution is gleaned primarily from the analysis of the energy spectrum, which is closely related to the binding energies of the molecular orbitals. There has also been an increased awareness of other data acquired in the study of photoelectron events, such as photoelectron cross sections, angular distributions of the ejected photoelectron, and satellite structure. Photoelectron spectroscopy and molecular orbital theory have gone hand in hand in creating an ever clearer description of both simple and complex molecules. In the future, photoelectron spectroscopy will provide not only a basis for molecular orbital theory, but may also be increasingly used in the prediction and study of chemical reactions. (150 refs) (auth)

11145 **Mass spectrometry of p-toluenesulfonamides: useful amine identification derivatives.** Singer, G.M.; Lijinsky, W.; Rainey, W.T. Jr. (Oak Ridge National Lab., TN). *Org. Mass Spectrom.*; **10**: 473-479(1975).

The mass spectral fragmentation patterns of p-toluenesulfonamides were determined and were found useful for identification of naturally occurring amines. (auth)

11146 **X-ray spectrometric analysis of plutonium—zirconium alloys.** Walden, J.C.; Wallace, P.L.; Magana, J.W. (Univ. of California, Livermore). *Appl. Spectrosc.*; **29**: No. 2, 175-178(1975).

An x-ray spectrometric method for analyzing binary plutonium-zirconium alloys containing 1 to 25 wt percent Zr has been developed. The alloys are analyzed as solutions in 8 M nitric acid. Yttrium is added as an internal standard. The techniques involved in handling and containing the radioactive solutions in conventional liquid cells are described in detail. No modifications to the x-ray spectrometer are required. Adaptations of this method have been used for the analysis of binary plutonium-gallium and plutonium-uranium alloys. (auth)

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 10310, 10449, 11397

11147 (ORO—1797-62) **Thermodynamics of synergistic solvent extraction of zinc(II).** Nash, K.L.; Choppin, G.R. (Florida State Univ., Tallahassee (USA)). 1975. 17p. Dep. NTIS $3.50.

The thermodynamics of the synergistic solvent extraction of zinc(II) by TTA-TBP mixtures were studied using radiochemical techniques. The thermodynamic values of the extraction equations indicate that the mechanism of adduct formation by TBP with the $Zn(TTA)_2$ chelate involves expansion of the coordination number of the central metal ion from 4 to 5. The extraction of zinc(II) by DEHP—TBP mixtures was also studied but no synergistic effect was seen in this extraction system. (auth)

11148 **Removal of Zn or Cd and cyanide from cyanide electroplating wastes.** Moore, F.L. (to U.S. Energy Research and Development Administration). US Patent Application 556,353. Filed date 7 Mar 1975. 7p.

A method is described for the efficient stripping of stable complexes of a selected quaternary amine and a cyanide of Zn or Cd. An alkali metal hydroxide solution such as NaOH or KOH will quantitatively strip a pregnant extract of the quaternary ammonium complex of its metal and cyanide content and regenerate a quaternary ammonium hydroxide salt which can be used for extracting further metal cyanide values.

11149 (MLM—2003(tr)) **Column chromatographic separation of plutonium oxidation states with the system AG 50 X 8/HCl.** Specht, S.; Hoehlein, G. Translated by H. W. Kirby from *Radiochim. Acta*; **12**: 38-42(1969). 12p. Dep. NTIS $3.50.

An analytical method of column chromatography is described which permits the identification, with tracer amounts of plutonium, of the states of oxidation III, IV, and VI, which occur side by side, and of the colloidal plutonium present. The method employs the cation exchange resin AG 50 X 8 (300 and 400 mesh) and HCl as the eluant. The identification is based on the position of the elution bands obtained. The distribution coefficients K/sub d/, the separation factors α, the plate numbers N, and the HETP-values are shown as a function of HCl concentration and the optimum conditions of separation are discussed by examples. For comparison, the K/sub d/ values obtained for americium, sodium, and the rare earth metals praseodymium and europium are also mentioned. (auth)

11150 **Analytical system for rapid separation of tissue nucleotides at low pressures on conventional anion exchangers.** Khym, J.X. (Oak Ridge National Lab., TN). *Clin. Chem.*; **21**: No. 9, 1245-1252(1975).

An analytical anion-exchange procedure has been developed for the rapid separation of acid-soluble nucleotides (the so-called "free" or tissue nucleotides). It permits assay at low pressures

(275-415 kPa; 40-60 psi) in less than 1 h on 10-cm columns of Aminex resins (conventional styrene-type anion exchangers) with alkaline citrate solutions as the eluent. Separation variables have been investigated, to determine optimum conditions for the routine analysis of samples containing tissue nucleotides. Also described here is a simple solvent-extraction procedure for removing $HClO_4$ or CCl_3CO_2H quantitatively from cell extracts that contain acid-soluble nucleotides: they are removed from aqueous acid solutions with a water-insoluble amine dissolved in a water-immiscible solvent. (auth)

11151 Acid pre-treatment method for in situ ore leaching. Mallon, R.G.; Braun, R.L. (to U.S. Energy Research and Development Administration). US Patent 3,915,499. 28 Oct 1975. Filed date 23 Jul 1974. 6p.

PAT-APPL-491,081.

An acid leaching method is described for the recovery of a desired element from a subterranean rubblized body of primary ore containing the element and also having associated therewith a carbonate mineral wherein the rubblized ore body is flooded with an aqueous acidic solution in order to release carbon dioxide from the associated carbonate mineral. After a substantial portion of the available carbon dioxide is released and removed from the ore body, as by venting to the atmosphere, an oxidizing gas is introduced into the flooded, rubblized ore to oxidize the ore and form an acid leach solution effective in the presence of the dissolved oxidizing gas to dissolve the ore and cause the desired element to go into solution. The leach solution is then circulated to the surface where the metal values are recovered therefrom.

11152 Recovery of fission products from waste solutions utilizing controlled cathodic potential electrolysis. Carlin, W.W.; Darlington, W.B. (to PPG Industries, Inc.). US Patent 3,922,231. 25 Nov 1975. Filed date 24 Nov 1972. 20p.

Fission products, e.g., palladium, rhodium and technetium, are recovered from aqueous waste solutions thereof, e.g., aged Purex alkaline waste solutions. The metal values from the waste solutions are extracted by ion exchange techniques. The metals adsorbed by the ion exchange resin are eluted and selectively recovered by controlled cathodic potential electrolysis. The metal values deposited on the cathode are recovered and, if desired, further purified. (Official Gazette)

11153 New process for americium purification. Proctor, S.G. (Dow Chemical USA, Golden, CO). *J. Less-Common Met.*; **44**: 195-199(Jan 1976).

A method of purifying americium has been developed which makes use of the solubility of the americyl ion (AmO_2^{++}) in the presence of fluoride ion. This precipitation process was primarily designed for the removal of rare-earth impurities; however, in addition, purification from most common elemental impurities can be expected. The process developed has been used to produce AmO_2 with no detectable rare-earth impurities and only 600 ppM total impurities. (auth)

11154 Experimental evidence of laser-induced separations in bulk gas mixtures. Rinehart, E.A.; Richardson, J.H.; Johnson, D.C.; Hrubesh, L.W. (University of California, Lawrence Livermore Laboratory, P. O. Box 808, Livermore, California 94550). *Appl. Phys. Lett.*; **28**: No. 3, 131-132(1 Feb 1976).

Radiation from a cw CO_2 laser is used to separate SF_6 molecules from helium molecules in a bulk mixture of each, by resonant radiation pressure. These experimental results demonstrate that selective absorption of radiation can cause physical separations of molecules within a diffusion-limited geometry. (AIP)

INORGANIC AND PHYSICAL CHEMISTRY

REFER ALSO TO CITATION(S) 10408, 11174

11155 (ORNL—5078, pp 28-51) **Chemistry.** Ferris, L.M. Feb 1976.

In Molten-salt reactor program. Semiannual progress report for period ending August 31, 1975.

Research progress is reported in programs on fuel-salt chemistry, properties of compounds in the Li—Te system, Te spectroscopy, UF_4—H equilibria, porous electrode studies of molten salts, fuel salt-coolant salt reactions, thermodynamic properties of transition-metal fluorides, and properties of sodium fluoroborate. Developmental work on analytical methods is summarized including in-line analysis of molten MSBR fuel, analysis of coolant-salts for tritium, analysis of molten LiF—BeF_2—ThF_4 for Fe and analysis of LiF—BeF—ThF_4 for Te. (JRD)

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 10331, 10399, 10427, 11013, 11113, 11176, 11201, 11707

11156 (AD/A—006681) **Unusual metalloporphyrins. Technical report.** Tsutsui, M.; Hrung, C. (Texas Agricultural and Mechanical Univ., College Station (USA). Dept. of Chemistry). 1975. Contract N00014-68-A-0308-0006. 17p. NTIS $3.25.

The chemistry of unusual metalloporphyrins is reviewed. Various transition metal complexes, including carbonyl compounds are discussed. Structures are included. (GRA)

11157 (AD/A—007262) **High resolution spectra of rare earth crystals. Final report, 2 Oct 1969-30 Sep 1973.** Crosswhite, H.M. (Johns Hopkins Univ., Baltimore, Md. (USA)). Mar 1975. Contract DAHC04-70-C-0007. 8p. NTIS $3.25.

Energy levels derived from the spectra of triply-ionized rare earths in hexagonal lanthanum trichloride single crystals have been reinterpreted using an expanded Hamiltonian including two- and three-body electrostatic and two-body magnetic effective operators in the free-ion part, and two-body crystal field operators added to the crystal interaction part. A method has been developed for dealing with the very large matrix dimensions encountered for ions in the middle of the series. (GRA)

11158 (ANL—75-46) **Chemical Engineering Division physical inorganic chemistry annual report, July 1974—June 1975.** Blander, M.; Cajigas, C.J.; Huang, H.S. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 47p. Dep. NTIS $5.50.

Thermal conductivity measurements of methanol vapor were made in a hot-wire cell at temperatures ranging from 306 to 345°K and pressures from 80 to 760 torr. Emf measurements of the activities of Li in Li-Mg alloys indicate small negative deviations from ideal behavior. Conformal ionic solution theory has been extended to fourth order for additive ternary molten salt systems (AX-BX-CX). A miscibility isotherm at 540°C for the Na,Ag parallel NO_3,Br system measured by a visual titration method appears to be consistent with theoretical considerations. Certain phase relationships in the systems, Li-Fe-S, Li-Cu-Fe-S, and Li-Co-Fe-S at 400°C, which are of interest to the lithium/metal sulfide battery program, were investigated. Emf measurements of Li-Al alloys relative to lithium were made. A value for the free energy of formation of Li_xC_6 was obtained from emf measurements. A study of the crystallization of metastable supercooled molten MgO-SiO_2 droplets was made as a function of composition and temperatures. An examination of the diffusion of oxygen isotopes in mineral grains indicates that the oxygen isotope anomalies found by Clayton et al., in inclusions in the Allende meteorite appear to have been formed by diffusion of ^{17}O and ^{18}O into materials very low in these isotopes. (auth)

11159 (PB—240177) **Workshop on fundamental research in homogeneous catalysis as related to U.S. energy problems, held at Stanford University, Stanford, California on December 4-6, 1974. Final report.** Collman, J.P.; Halpern, J.; Norton, J.; Roth, J. (Stanford Univ., Calif. (USA)). 6 Dec 1974. 43p. NTIS $3.75.

The major objectives of the Workshop were to identify opportunities for the solution of energy problems by homogeneous catalysts and to formulate recommendations for fundamental research in this area that could accelerate these solutions. The Workshop recognized the following areas of research as particularly important, relatively neglected at present, and potentially fruitful: (1) The homogeneous catalytic activation of saturated hydrocarbons. (2) Selective oxidation of organic substances and the activation of oxygen, including electrode surface studies. (3) The reduction of carbon monoxide, especially by hydrogen, including studies on the mechanism of Fischer-Tropsch synthesis and on homogeneously catalyzed analogs of the latter. (4) Studies on multi-metal catalyst systems, including polynuclear complexes as well as multi-function catalysts involving combinations of different metal ions. (5) Production of high energy substances such as hydrogen from water. (6) Catalytic complexes involving unusual metal environments. (GRA)

11160 Experimental and calculated solubilities of magnesium sulfate monohydrate in aqueous nitric acid and related solubilities, 200 to 350°C: ionization constants of nitric acid at 300 to 370°C. Marshall, W.L.; Slusher, R. (Oak Ridge National Lab., TN). *J. Inorg. Nucl. Chem.*; **37**: 2165-2170(1975).

Of interest in predicting high temperature phase equilibria for geothermal power, desalination, general hydrothermal and other evaluations, solubilities of magnesium sulfate monohydrate have been determined in 0-1 m aqueous nitric acid solutions at 200-350°C. These solubilities also have been calculated independently, with good agreement to 300°C, by applying earlier published values of solubility product constants (K/sub sp/) of the

salt, second ionization constants (K_2) of sulfuric acid, and ionization constants (K/sub n/) of nitric acid. The experimental solubilities, when treated by iterative equations and the resulting values of solubility products (Q/sub sp/) extrapolated to zero ionic strength, yielded values of K/sub sp/ essentially identical with those obtained from earlier solubility studies in aqueous sulfuric acid. From the experimental results at 350°C, a value of K/sub n/ was obtained that resolved its earlier uncertainty at this temperature and allowed revised thermodynamic functions to be presented at 300-370°C. Comparative solubilities of magnesium sulfate monohydrate in aqueous sodium nitrate solutions and of magnesium and calcium hydroxides in nitric acid are included. (auth)

11161 Cesium nitrate. Standard enthalpies of solution and formation and the standard entropy at 298.15 K. O'Hare, P.A.G.; Boerio, J. (Argonne National Lab., IL). *J. Chem. Thermodyn.*; **7**: 937-941(1975).

Calorimetric measurements on single-crystal $CsNO_3$ have yielded the standard enthalpy of solution at 298.15 K, ΔH^0/sub soln/ = (9639 +- 10) cal/sub th/mol^{-1}. Based on this value, the standard enthalpy of formation, ΔH^0/sub f/($CsNO_3$, c, 298.15 K) was calculated to be -(120.88 +- 0.12)kcal/sub th/mol^{-1}. Solubility and activity coefficient data for $CsNO_3$ gave 779 cal/sub th/mol^{-1} for the standard Gibbs energy of solution, ΔG^0/sub soln/. Thence, the standard entropy, S^0($CsNO_3$, c, 298.15 K), was deduced to be (37.1 +- 0.2)cal/sub th/K^{-1} mol^{-1}. (auth)

11162 (ORNL-tr—4082) Thermodynamic functions for complex formation and ionic radii. III. Statistical-thermodynamic analysis of the complex-formation constants in aqueous solutions. Muenze, R. Translated by E.G. Silver from *Z. Phys. Chem. (Leipzig)*; **256**: No. 4, 617-624(1975). 12p. Dep. NTIS $3.50.

Using simple potentials for the interaction between the reactants the conditions for the application of the experimentally verified equation between the ionic charges, ionic radii and polarizabilities for the reaction of complex formation in aqueous solution have been evaluated by statistical thermodynamics. The result permits conclusions concerning the transfer of such equations to other solvent systems. (auth)

11163 γ-tris-(2,4-pentanedionato)aluminum(III). McClelland, B.W. (Oak Ridge National Lab., TN). *Acta Crystallogr., Sect. B*; **B31**: 2496-2498(Oct 1975).

$C_{15}H_{21}AlO_6$ is orthorhombic with $Pna2_1$, a = 15.699 (3), b = 32.546 (7), c = 13.369 (2) A; Z = 16; D/sub m/ = 1.25 (1) (by flotation), d/sub x/ = 1.261 g cm^{-3}. Pale yellow transparent eight-sided prisms were obtained from commercially available material. The α and γ forms differ primarily in the relative orientations of the molecules. The average molecular structure is not significantly different from that observed in the α form. (auth)

11164 Ion backscattering study of Cu_xS formation on single crystal CdS. Borders, J.A. (Sandia Labs., Albuquerque, NM). *J. Electrochem. Soc.*; **123**: No. 1, 37-42(Jan 1976).

Ion backscattering was used to study the formation of Cu_2S layers on single crystal CdS due to the chemical ion exchange reaction: $2Cu^+ + CdS$ yields $Cu_2S + Cd^{++}$. The reaction was found to proceed most rapidly on the A (Cd) face, slower on the B (S) face, with the reaction proceeding slowest on faces perpendicular to the [11 anti 2 0] axis. Reactions on the A and B faces are characterized by a very nonuniform Cu_2S—CdS interface, whereas the interface for reactions along the [11 anti 2 0] is much more uniform. The reaction in the latter case may be controlled by surface nucleation, and layer formation subsequent to formation of a 300 to 500 A thick layer is much slower. The formation of Cu_2S on the A and B faces has an activation energy of 0.9 to 1.5 eV. Preparation of the surface by polishing leads to a larger rate of Cu_2S formation and Cu_2S—CdS interfaces which are more uniform as a function of depth than those in etched samples. (auth)

11165 Correlations for interacting Brownian particles. Ackerson, B.J. (Univ. of Colorado, Boulder). *J. Chem. Phys.*; **64**: No. 1, 242-247(1 Jan 1976).

The generalized Smoluchowski equation is employed to calculate the first two cumulants of decay of the intermediate scattering function for interacting colloidal particles. A model calculation is presented to investigate the behavior of the general form of the cumulants. The hydrodynamic interaction is examined and possible modifications of these results are discussed. (auth)

11166 Iodine—fluorine bond strength in IIF, ClIF, and HIF. Valentini, J.J.; Coggiola, M.J.; Lee, Y.T. (Univ. of California, Berkeley). *J. Am. Chem. Soc.*; **98**: No. 3, 853-854(4 Feb 1976).

The trihalogens, I_2F and ClIF, and the pseudo-trihalogen, HIF, were observed as a result of crossed supersonic beams of pure HI or I_2 or ICl in argon carrier gas crossed with a hyperthermal beam of fluorine molecules in helium or helium—neon mixture. The I-F binding energies were determined to be 33, 31, and 26 kcal/mole for the I_2F, ClIF, and HIF molecules respectively. Mass spectrometric analysis indicated a preference for the geometry in which the least electronegative atom was in the central position. (DDA)

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 11213, 11721

11167 Neutron diffraction study of hexaammine-d_3-calcium(0) at 75K. Von Dreele, R.B. (Arizona State Univ., Tempe); Glaunsinger, W.S.; Bowman, A.L.; Yarnell, J.L. *J. Phys. Chem.*; **79**: No. 26, 2992-2995(18 Dec 1975).

The structure of $Ca(ND_3)_6$ was determined by powder neutron diffraction at 75°K. The atomic parameters were refined by least-squares fitting of the diffraction profile. $Ca(ND_3)_6$ crystallizes in the space group Im3m with a = 9.0137(4) A and Z = 2. The standard profile residual was 0.109 for eight parameters and a profile range 10° less than or equal to 2 theta less than or equal to 50° for lambda = 1.27963 A. $Ca(ND_3)_6$ has highly distorted ND_3 molecules arranged in an exact octahedron around the Ca atoms with fourfold rotational disorder for each ND_3. The Ca—N distance is 2.69 A. One N—D bond is normal, 0.94 A, while the other two are extremely long, 1.39 A. There is no hydrogen bonding in the structure and virtually all nonbonded contacts are greater than van der Waals distances. (auth)

11168 Hydrogen abstraction reactions by atomic fluorine. IV. Temperature dependence of the intermolecular kinetic isotope effect for the nonthermal $^{18}F+H_2$ reaction. Grant, E.R.; Root, J.W. (Department of Chemistry and Crocker Nuclear Laboratory, University of California, Davis, California 95616). *J. Chem. Phys.*; **64**: No. 1, 417-426(1 Jan 1976).

The nuclear recoil systems ^{18}F vs H_2/C_3F_6 and ^{18}F vs D_2/C_3F_6 were investigated from 273—347 degreeK over the full range of mixture compositions at a constant pressure of 1000 Torr. The results were systematized and interpreted within a nonthermal bimolecular rate constant framework. The phenomenological rate constants as well as their purely non-Boltzmann components exhibited significant composition and ambient temperature dependences. Most, if not all, of this latter effect was attributable to the $^{18}F^*+C_3F_6$ reaction channel, either through an internal state coupling mechanism or through secondary decomposition of excited $CF_3CFCF_2{}^{18}F$ radicals by ^{18}F-atom loss. Preferred values for the thermal reaction fractions in extrapolated pure H_2 (or D_2) and C_3F_6 systems were 20+-10% and 20+-20%. The corresponding average intermolecular kinetic isotope effect for the pure non-Boltzmann $^{18}F+H_2$ reaction was 1.3+-0.1. (AIP)

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 10288, 11184

11169 (ORNL/TM—5191) Isotope separations section progress report for quarter ending September 30, 1975. Newman, E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 12p. Dep. NTIS $4.50.

Work on the separation of stable and radioactive isotopes is outlined. Included are recovery of ^{235}U, and enrichment of ^{41}Ca and ^{208}Pb. Progress is reported in research on the improvement of rare earth isotope separation. (JGB)

11170 (UCRL-Trans—10994) Heterogeneous ion-exchange reactions on silver salts. Reber, K. Translated from *Photographische Korrespondenz*; **105**: No. 11, 175-179(1969). 16p. Dep. NTIS $3.50.

The kinetics of heterogeneous ion exchange reactions on thin AgBr crystals with Ag^+-solution were investigated using /sup 110m/Ag; they are controlled by the speed of the interface reaction as well as by the self-diffusion coefficient in the solid D/sup S/. Both increase with increasing Ag^+-concentration, D/sup S/ from 5.2 . 10^{-11} to 1.2 . 10^{-9} cm^2/hour in the P/sub Ag/ range between 6.2 and 2.7. The interface reaction is not affected by adsorbed substances. The exchange kinetics of the system silver behenate and Ag^+ in solution is controlled solely by the diffusion in the solid. D/sup S/ is about 10^{-12} cm^2/hour. Between AgBr and $^{109}Cd^{2+}$ in solution no exchange occurs, neither are Cd^{2+}-ions adsorbed on (100) faces when their concentration is very small (10^{-9} molar). (auth)

11171 Method for separating isotopes. Jepson, B.E. (to U.S. Energy Research and Development Administration). US Patent 3,914,373. 21 Oct 1975. Filed date 20 Jan 1973. 10p.

PAT-APPL-322,564.

Isotopes are separated by contacting a feed solution containing the isotopes with a cyclic polyether wherein a complex of one isotope is formed with the cyclic polyether, the cyclic polyether complex is extracted from the feed solution, and the isotope is thereafter separated from the cyclic polyether.

11172 Dual temperature concentration system. Spevack, J.S. (to Deuterium Corp.). US Patent 3,920,395. 18 Nov 1975. Filed date 26 Sep 1966. 12p.

In a dual temperature isotope exchange system—exemplified by exchange of deuterium and protium between water and hydrogen sulfide gas in hot and cold towers, in which the feed stream (water) containing the desired isotope is passed through a pair of towers maintained at different temperatures wherein it effects isotope exchange with countercurrently circulated auxiliary fluid (H_2S) and is impoverished in said isotope and then disposed of, e.g. discharged to waste,—the flow of isotope enriched auxiliary fluid between said towers (hot H_2S saturated with water vapor) is divided and a part thereof is adjusted in its temperature (to cold tower conditions) and then passed to the auxiliary fluid impoverishing (cold) tower, while the remainder of the divided flow of such enriched auxiliary fluid is passed through a subsequent isotope concentration treatment to produce a product more highly enriched in the desired isotope and wherein it is also adjusted in its temperature and is impoverished in said isotope during said subsequent treatment before it is delivered to the said auxiliary fluid impoverishing (cold) tower. Certain provisions are made for returning to the hot tower liquid carried as vapor by the remainder of the divided flow to the subsequent isotope concentration treatment, for recovering sensible and latent heat, and for reducing passage of auxiliary fluid to waste. (Official Gazette)

11173 Lithium isotope separation factors of some two-phase equilibrium systems. Palko, A.A.; Drury, J.S.; Begun, G.M. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.*; **64**: No. 4, 1828-1837(15 Feb 1976).

Isotope separation factors of seventeen two-phase equilibrium systems for lithium isotope enrichment have been determined. In all cases, lithium amalgam was used as one of the lithium-containing phases and was equilibrated with an aqueous or organic phase containing a lithium compound. In all systems examined, isotopic exchange was found to be extremely rapid, and ^{6}Li was concentrated in the amalgam phase. The isotopic separation factor for the LiOH(aqueous) vs Li(amalgam) system has been studied as a function of temperature from -2 to 80 degreeC. The values obtained have been compared with the "electrolysis" and exchange separation factors given in the literature. The two-phase systems, LiCl(ethylenediamine) vs Li(amalgam) and LiCl(propylenediamine) vs Li(amalgam), have been studied, and the isotopic separation factors have been determined as functions of the temperature. The factors for the two systems have been found to be substantially the same (within limits of the errors involved) over the temperature range studied (0 to 100 degreeC) as those for the aqueous system. The isotopic separation factors for the seventeen systems have been tabulated, and correlations have been drawn that show the salt and solvent effects upon the values obtained. (AIP)

ORGANIC CHEMISTRY

11174 (UCLA—34P218X2) **Multiheteromacrocycles that complex metal ions. Second progress report, 1 May 1975—30 April 1976.** Cram, D.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jan 1976. Contract AT(04-3)-34. 22p. Dep. NTIS $3.50.

Objective is to develop cyclic and polycyclic host organic compounds to complex and lipophilize metal ions. Macrorings were synthesized: $(OCH_2\ CH_2\ O\ CH_2COCH_2\ COCH_2)_3$ and $(OCH_2\ CH_2\ O\ CH_2\ COCH_2\ COCH_2)_3$. The smaller ring complexes divalent metals 10^{1+8} times better than the open-chain model $CH_3\ O\ CH_2\ CO\ CH_2\ COCH_2\ O\ CH_3$, and the order in which metal ions are complexed is Cu^{2+}, UO_2^{2+} greater than Ni^{2+} greater than Fe^{2+}, Co^{2+}, Zn^{2+}, Cd^{2+} greater than Mn^{2+}. The UO_2^{2+} and Cu^{2+} complexes were isolated and characterized. The larger ring complexes trivalent metals 10/sup 0.9-1.7/ times better than the open-chain model compound, and the order is La^{3+}, Ce^{3+} greater than Cr^{3+}. Five other macrocycles were also synthesized, and their binding constants with Na, K, NH_4, and Cs picrates were measured. Six compounds containing one macroring and two inward-pointing ArOH or $ArOCH_3$ groups were also prepared and tested for binding of Li, Na, K, Rb, and NH_4 picrates. Racemic compounds containing two binaphthyls and its sulfur analog were prepared. Cage-shaped multiheteromacrocycles containing ten O ligand sites or four S and six O ligand sites were prepared and the binding capability of the first compound for picrates studied. Two ring systems with phosphonate ester groups were also prepared. (DLC)

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 10394, 11156, 11163

11175 (CEA-N—1814) **Infrared determination of the orientation of molecules in stearamide monolayers.** Chollet, P.A.; Messier, J.; Rosilio, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). Jul 1975. 35p. (In French). INIS.

The orientation of molecules in the monomolecular stearamide monolayers has been studied by infrared linear dichroism. By comparing the transmission absorption spectra carried out at different angles of incidence with the reflection absorption spectra obtained by depositing the monolayers on a metal substrate, the orientation of the dipole transition moments for a great number of normal vibration modes of the molecules may be determined to within a few degrees accuracy. Given certain assumptions, the orientation of the molecules themselves can then be deduced. (FR)

11176 (ORNL/TM—5115) **STATEQ: a nonlinear least-squares code for obtaining Martin thermodynamic representations of fluids in the gaseous and dense gaseous regions.** Milora, S.L. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 132p. Dep. NTIS $7.00.

The use of the code NLIN (IBM Share Program No. 1428) to obtain empirical thermodynamic pressure-volume-temperature (P-V-T) relationships for substances in the gaseous and dense gaseous states is described. When sufficient experimental data exist, the code STATEQ will provide least-squares estimates for the 21 parameters of the Martin model. Another code, APPROX, is described which also obtains parameter estimates for the model by making use of the approximate generalized behavior of fluids. Use of the codes is illustrated in obtaining thermodynamic representations for isobutane. (auth)

11177 1-methyl-4-thiouracil. Hawkinson, S.W. (Oak Ridge National Lab., TN). *Acta Crystallogr., Sect. B;* **B31**: 2153-2156(Aug 1975).

$C_5H_6N_2OS$, monoclinic, $P2_1/c$, a = 6.757(1), b = 13.618(2), c = 7.010(1) A, β = 99.36(1)°, Z = 4, D/sub c/ = 1.484, D/sub m/ = 1.488 g cm^{-3}, V = 636.45 A^3, F.W. 142.2, λ(Cu Kα_1) = 1.5405 A, μ = 36.7 cm^{-1}, F(000) = 296. The intensity data were collected on an automated diffractometer and the structure was solved by the heavy-atom technique. Full-matrix least-squares refinement yielded an R of 0.033 for 978 reflections. The molecules form dimers in the crystal via N(3)-H(3)...S hydrogen bonds (N-S distance 3.328 A). The crystal structure is similar to that of the more stable form of l-methylthymine [Hoogsteen, Acta Cryst. (1963), 16, 28-38]. (auth)

11178 Configuration of dienestrol. Doyle, T.D. (Dept. of Health, Education, and Welfare, Washington, DC); Stewart, J.M.; Filipescu, N.; Benson, W.R. *J. Pharm. Sci.;* **64**: No. 9, 1525-1528(Sep 1975).

Uncertainty concerning the configuration of dienestrol was resolved by a detailed spectrochemical investigation, including single-crystal x-ray diffraction, of the active drug and its stereoisomers. A symmetric structure in which the phenyl and methyl groups are cis about each double bond is unambiguously assigned. (auth)

11179 Process for producing 1,5-diacetyl-3,7-dinitro-1,3,5,7-tetraazacyclooctane. Coburn, M.D.; Benziger, T.M. (to U.S. Energy Research and Development Administration). US Patent 3,926,953. 16 Dec 1975. Filed date 5 Dec 1974. 4p.

PAT-APPL-529,988.

Diacetyl pentamethylene tetramine in solution in acetic acid is converted to 1,5-diacetyl-3,7-dinitro-1,3,5,7-tetraazacyclooctane by nitrolysis in a mixture of nitric and sulfuric acid. The amount of nitric acid required for this purpose may be reduced to near-stoichiometric levels and a resultant hazardous exothermic reaction avoided by the addition of urea to the acetic acid solution of diacetyl pentamethylenetetramine before nitrolysis occurs. 4 claims, 2 drawing figures.

11180 Measurement of Fe—S bond lengths in rubredoxin using extended x-ray absorption fine structure (EXAFS). Sayers, D.E.; Stern, E.A.; Herriott, J.R. (Univ. of Washington, Seattle). *J. Chem. Phys.;* **64**: No. 1, 427-428(1 Jan 1976).

The EXAFS technique, which has been used to study the local structure about particular atoms in a variety of complex systems, is used to study the Fe-S bond lengths in Clostridium pasteurianum rubredoxin. An average bond length of 2.30 A +-

0.04 A and a root mean square (rms) deviation about this average of 0.06 A +- 0.04 A are found. (auth)

11181 Evidence for the dimerization of dimethylsilylene to tetramethyldisilene. Conlin, R.T.; Gaspar, P.P. (Washington Univ., St. Louis). *J. Am. Chem. Soc.*; **98**: No. 3, 868-870(4 Feb 1976).

Evidence is presented for the formation of disilacyclobutane products along with data consistent with the formation of these products in a second-order reaction of silylenes, and the minor products are considered. Reaction conditions and product yields are given for the pyrolysis of pure dimethoxytetramethyldisilane and for the copyrolysis of the disilane and a tenfold excess of propyne, the latter compound acting as a substrate for dimethylsilylene addition. Spectroscopic data for the disilacyclobutanes and for the propyne adduct of dimethylsilylene are tabulated; and the formation of the minor products trimethylsilane and 1,1,3-trimethyl-1,3-disilacyclobutane is discussed. (auth)

ISOTOPE EFFECTS

11182 (TID—26949) **Hydride shifts in the 2-norbornyl cation.** Schmidt, W.W. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. 89p. Dep. NTIS $5.00.

Thesis.

Deuterium labeling was used in two separate but related solvolyses to evaluate endo,endo-6,2-hydride (6,2-H) and exo,exo-3,2-hydride (3,2-H) shifts in the 2-norbornyl cation. (auth)

11183 Photoionization mass spectrometric study of formaldehyde H_2CO, HDCO and D_2CO. Guyon, P.M.; Chupka, W.A.; Berkowitz, J. (Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.*; **64**: No. 4, 1419-1436(15 Feb 1976).

Photoionization efficiency curves for H_2CO^+, $HDCO^+$, D_2CO^+ and HCO^+, DCO^+ and CO^+ fragment ions are obtained. The ionization potentials of H_2CO, HDCO, and D_2CO thus determined are, respectively, 10.86_9, 10.87_9, and 10.88_2 eV. The appearance potential of HCO^+ fragment is observed at 11.92+-0.01 eV, from which the dissociation energy of H_2CO^+, the proton affinity of CO, and the ionization potential of HCO are inferred. The heat of formation $\Delta Hf°_0$ (HCO^+) =196.2+-0.5 kcal/mole is obtained, a value lower than any one previous determination. From the abundance ratios measurements the variation of the mass spectrum with photon energy is determined, and hydrogen isotope effects are measured. The observation of a metastable transition (D_2CO^+)/subm/yieldsDCO$^+$+D with a threshold some 2 eV above the dissociation limit is discussed along with the dissociation mechanisms with the help of correlation diagrams. Finally, the finer structure in the photoionization efficiency curves is analyzed in terms of preionized Rydberg series converging to the second and third electronic state of the ion. (AIP)

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 11187, 11677

11184 (MIT—2793-1) **Nonequilibrium photochemical reactions induced by lasers. Quarterly progress report, July 1, 1975—September 30, 1975.** Steinfeld, J.I. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). Oct 1975. Contract E(11-1)-2793. 6p. Dep. NTIS $3.50.

Progress is reported in the following areas of research: ir double resonance of SF_6; ir-laser-induced chemistry; and, laser-driven thermal isotope diffusion, inducing ^{10}B enrichment. (JGB)

11185 Quenching of the luminescenceof the tris(2,2′-bipyridine) complexes of ruthenium(II) and osmium(II). Kinetic considerations and photogalvanic effects. Lin, C.T.; Sutin, N. (Brookhaven National Lab., Upton, NY). *J. Phys. Chem.*; **80**: No. 2, 97-105(15 Jan 1976).

The quenching of the charge-transfer excited states of $Ru(bpy)_3^{2+}$ and $Os(bpy)_3^{2+}$ by O_2, Fe^{3+}, $Co(phen)_3^{3+}$, $Ry(NH_3)_6^{3+}$, $Os(bpy)_3^{3+}$, and $Fe(CN)_6^{3-}$ has been studied by a spectrofluorometric method. The lifetime of the emitting state of the osmium (II) complex and the rate of its reaction with $Ru(NH_3)_6^{3+}$ were measured by a single-photon counting technique. A value of -0.96 V was estimated for the reduction potential of the $Os(bpy)_3^{2+}$ parallel $*Os(bpy)_3^{2+}$ couple. Emission intensity measurements were used to determine the steady-state concentrations of the Fe^{2+} and $Ru(bpy)_3^{2+}$ formed in the reaction of Fe^{3+} with the emitting state of $Ru(bpy)_3^{2+}$. The steady-state concentrations of the electron-transfer products increase in the order HCl < H_2SO_4 < $HClO_4$ ~ CF_3SO_3H and in 0.5 M $HClO_4$ amount to about 25 percent of the initial $Ru(bpy)_3^{2+}$ concentration under the conditions used. The $Ru(bpy)_3^{2+}$-Fe^{2+} system exhibits a large photogalvanic effect. The mechanisms of the reactions are discussed and general equations describing the steady-state characteristics of these systems are derived. (auth)

RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 10325, 10382, 11119

11186 (AD/A—008148) **Free radical-induced chain breakage in irradiated aqueous solutions of DNA.** Meaburn, G.M.; Cole, C.M. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Mar 1974. 21p. (AFRRI-SR—74-3). NTIS $3.25.

The extent of chain breakage induced by free radical attack of calf thymus DNA in dilute aqueous solution has been determined by assay of liberated phosphomonoester groups. The relative effectiveness of hydroxyl radicals and hydrated electrons as initiators of this type of damage was investigated in both native and denatured DNA exposed to ^{60}Co γ and 40-MeV electron radiation in the absence of oxygen. Approximately 8 percent of available OH and 6 percent of hydrated electrons react to produce chain breaks in double-stranded DNA, whereas these values are reduced to 5 percent and 1-2 percent respectively, for the denatured material. The double helical polynucleotide structure provides protection for reactive sites on the bases which are fully exposed to attacking radicals in single-stranded DNA. (GRA)

11187 (COO—3118-10) **Effects of mercaptans and disulfides on photochemical and high energy radiation induced reactions. Progress report, November 1, 1974—October 31, 1975.** Cohen, S.G. (Brandeis Univ., Waltham, Mass. (USA)). Oct 1975. Contract E(11-1)-3118. 10p. Dep. NTIS $3.50.

A chain reaction may be formulated at alkaline pH in terms of e^-/sub aq/ acting as a source of ^-OH as a reactant and H. regenerating e^-/sub aq/. This may account for radiolytic conversion of CO to formate with high G. ^{60}Co γ-radiolysis of alkaline aqueous acetonitrile and acetamide gave no evidence of a chain; extensive hydrolysis of methyl acetate is now attributed to non-radiolytic, normal hydrolysis. Aromatic mercaptans are found to retard photoreduction of a benzophenone by aliphatic amines, largely by hydrogen atom-transfer repair reactions. Aliphatic mercaptans accelerate photoreduction, apparently by affecting the reduction to quenching ratio in the intermediate charge-transfer complex. In photoreduction of a benzophenone by 2,3-butylene glycol at pH 3, the glycol is converted, not to 3-hydroxy-2-butanone, but to 2-butanone, and about 4 molecules of this are formed per molecule of ketone reduced. A short chain appears to be established. Mercaptan appears to accelerate the reduction of the ketone and retard the formation of 2-butanone. (auth)

11188 (COO—3435-28) **Microwave-optical double resonance spectroscopy. Progress report, February 1, 1975—January 31, 1976.** Pratt, D.W. (Pittsburgh Univ., Pa. (USA). Dept. of Chemistry). 1 Nov 1975. Contract AT(11-1)-3435. 29p. Dep. NTIS $4.00.

Zero-field and high-field optical detection of magnetic resonance (ODMR), electron paramagnetic resonance (EPR), and optical spectroscopy experiments were performed on several systems in order to further basic knowledge of the structure, reactions, and response to radiation of atoms, molecules, and ions. Results on the following studies are reported: the direct observation of level anticrossing and mixing effects in excited molecular triplet states; anomalous zero-field splittings in the lowest triplet state of 1-iodonaphthalene; evidence for second-order spin-orbit coupling and spin delocalization effects in the lowest triplet state of benzophenone; direct observation of the optical absorption spectra of reactive free radicals at room temperature; measurements of the activation and thermodynamic parameters of several cyclohexenyl and cyclohexanonyl radicals; complete analyses of the level anticrossing and cross relaxation spectra of oriented molecular triplet states; solutions to the spin Hamiltonian for S = 1, I = 5/2 systems in both zero-field and high-field, an improvement by a factor of ten in the resolution of ODMR experiments in high field; and measurements of the optical and magnetic resonance properties of a series of halogenated naphthalenes in their lowest triplet states. (auth)

11189 Radiation-induced homolytic aromatic substitution. V. Effect of metal ions on the hydroxylation of toluene. Eberhardt, M.K.; Martinez, M.I. (Puerto Rico Nuclear Center, San Juan). *J. Phys. Chem.*; **79**: No. 18, 1917-1920(1975).

The radiation-induced hydroxylation of toluene was investigated in presence of $K_2Cr_2O_7$, $K_3Fe(CN)_6$, $K_4Fe(CN)_6$, $Fe(ClO_4)_3$·$9(SO_4)_3$, $CuSO_4$, $Cu(ClO_4)_2$, and $Cu(OCOCH_3)_2$. With $K_2Cr_2O_7$, $K_3Fe(CN)_6$, and the Cu^{2+} salts high conversions of the OH radicals to cresols were obtained. In all these cases the isomer distribution obtained at the highest concentration in-

vestigated (5×10^{-2} M) was the same 49 to 52 percent ortho, 22 to 24 percent meta, and 26 to 28 percent para). With the exception of $K_3Fe(CN)_6$ the percentage of G(m-cresol) increased with increasing concentration of metal salt. The pH had a marked effect on the formation of cresols due to the competing acid-catalyzed elimination of water from the initially formed hydroxymethylcyclohexadienyl radicals to give benzyl radicals. No reduction of the hydroxymethylcyclohexadienyl radicals by $Fe(CN)_6^{4-}$ was observed. For the rate of oxidation of the hydroxymethylcyclohexadienyl radicals the following sequence was established: $Fe(CN)_6^{3-}$ greater than Cu^{2+} greater than Fe^{3+}.

11190 Method for removing and decolorizing aqueous waste effluents containing dissolved or dispersed organic matter. Case, F.N.; Ketchen, E.E. (to U.S. Energy Research and Development Administration). US Patent 3,912,625. 14 Oct 1975. Filed date 5 Nov 1973. 6p.

PAT-APPL-412,850.

A method is provided for treating organic waste material dissolved or dispersed in an aqueous effluent, which comprises contacting the effluent with an inert particulate carbonaceous sorbent at an oxygen pressure up to 2000 psi, irradiating the resultant mixture with high energy radiation until a decolorized liquid is produced, and then separating the decolorized liquid.

11191 Alteration of an annealed and irradiated lunar fines sample by adsorbed water. Holmes, H.F.; Agron, P.A.; Eichler, E.; Fuller, E.L. Jr.; O'Kelly, G.D.; Gammage, R.B. (Oak Ridge National Lab., Tenn. (USA)). *Earth Planet. Sci. Lett.*; **28**: No. 1, 33-36(Nov 1975).

Apollo 12 lunar fines sample 12070,403 was annealed at 1000°C and subsequently irradiated with a beam of 130 MeV Fe^{9+} ions. Adsorptions of nitrogen and water were measured before and after the irradiation. Prior to the irradiation, the fines were nonporous and water had no effect on the physical characteristics of the lunar fines. In contrast, after the irradiation, the interaction with water caused an increase in the specific surface area and created a pore system. These results are definitive evidence that the interaction of water with damage tracks is the prime factor involved in the alteration of lunar fines by absorbed water. (NL)

11192 Role of ab initio calculations in elucidating properties of hydrated and ammoniated electrons. Newton, M.D. (Brookhaven National Lab., Upton, NY). *J. Phys. Chem.*; **79**: No. 26, 2795-2808(18 Dec 1975).

The properties of solvated electrons are analyzed in terms of a self-consistent modified continuum model based on the techniques of ab initio molecular quantum mechanics. The model is semiclassical in spirit, employing the quantum mechanical density for the excess charge and the first solvation shell in conjunction with classical electrostatics, and is developed in a general form which can be straightforwardly applied to special cases of interest, such as the solvated mono- and dielectron complexes. The advantages and disadvantages of the technique are discussed in relation to other more empirical approaches. Computational results are presented for excess electrons (mono- and dielectrons) in water and ammonia, and the role of long-range polarization of the medium in localizing the excess charge is analyzed. The variationally determined ground states are characterized in terms of equilibrium solvation shell geometry (appreciable cavities are implied for both water and ammonia), solvation energy, photoionization energy, and charge distribution. The finding of negative spin densities at the first solvent shell protons underscores the importance of a many electron theoretical treatment. Preliminary results for excited states are also reported. The calculated results are compared with experimental and other theoretical data, and the sensitivity of the results to various features of the model is discussed. Particular attention is paid to the number of solvent molecules required to trap the excess electron. (auth)

11193 Pulse radiolysis study of solvated electrons in water—ethanol glasses at 76K. Structure of the first solvation shell around the electron. Kevan, L. (Wayne State Univ., Detroit). *J. Phys. Chem.*; **79**: No. 26, 2846-2848(18 Dec 1975).

The initial spectrum of the trapped electron at less than or equal to 200 nsec in anhydrous C_2D_5OD glasses at 76°K has lambda/sub max/ approximately 1300 nm and shifts with time to a stable position near 540 nm. The presence of water in C_2D_5OD—D_2O glass causes a large increase in the visible portion and a decrease in the infrared portion of the initial spectrum, suggesting that the initial time scale for the solvation process is more rapid when a water molecule is in the first solvation shell of the electron, or that water induces specific structural arrangements of shallow trapping molecular configurations. From the effect of water on the spectra, a simple analysis indicates that there are four molecules in the average first solvation shell of the electron. (auth)

11194 Trapped electrons in organic glasses. Willard, J.E. (Univ. of Wisconsin, Madison). *J. Phys. Chem.*; **79**: No. 26, 2966-2973(18 Dec 1975).

The experimental observations dealing with trapped electrons in organic glasses which are most revealing as to the nature of the trapping process are discussed, and a model of trapping which they suggest is outlined. Data from optical and ESR spectrometry, differential thermal analysis, bleaching, decay, and scavenger studies are cited. It appears that after mobile electrons produced by γ irradiation or photoionization of solutes are thermalized they first become stabilized in weak traps through polarization and dipole interactions and then deepen these traps by molecular orientation at rates dependent on the polarity of the matrix molecules and the temperature. The data suggest that the stabilized condition at any temperature involves a continuum of trap depths in which the electrons give optical spectra of different lambda/sub max/ which add up to give the broad observed spectrum. The energy of a photon absorbed by an electron in excess of the detrapping threshold for that electron determines whether the electron can migrate far enough to encounter a capturing entity. If the energy is too low the electron is retrapped rather than being bleached. Evidence for capture of epithermal subexcitation electrons by some scavengers and on the heats of solvation of electrons and cations in organic glasses is also noted. (auth)

11195 Solvated electron as reducing species in the submicrosecond formation of reactive transients. Carbanions in solution. Dorfman, L.M.; Bockrath, B. (Ohio State Univ., Columbus). *J. Phys. Chem.*; **79**: No. 26, 3040(18 Dec 1975).

Carbanions were generated by dissociative attachment to organomercury compounds in tetrahydrofuran. In this way, the benzyl carbanion, $PhCH_2^-$, was formed and studied. It exhibits a uv absorption band with maximum at 362 nm. Absolute rate constants for its formation, as well as for the formation of ($PhCH_2^-$, Na^+), were determined. (JGB)

11196 Spectra of the solvated electron coupled with metal cations. Lithium in tetrahydrofuran. Bockrath, B.; Gavlas, J.F.; Dorfman, L.M. (Ohio State Univ., Columbus). *J. Phys. Chem.*; **79**: No. 26, 3064(18 Dec 1975).

Some recent data are presented on the aggregation of the solvated electron with an alkali metal cation for a specific system, namely lithium in tetrahydrofuran (THF). The ion pair (Li^+, e^-/sub sol/ formed in THF exhibits an absorption band with maximum at 1180 nm. The molar extinction coefficient at the maximum is 2.3×10^4 M^{-1} cm^{-1}, which gives an oscillator strength of 0.9 for the band. Absolute rate constants for the reaction of (Li^+, e^-/sub sol/) with anthracene, biphenyl, and dibenzylmercury in THF, at 25°C, were found to be 2.65×10^{10}, 1.00×10^{10}, and 1.8×10^{10} M^{-1} sec^{-1}, respectively. (JGB)

11197 Reactions and quenching of vibrationally excited hydroxyl radicals. Streit, G.E.; Johnston, H.S. (Univ. of California, Berkeley). *J. Chem. Phys.*; **64**: No. 1, 95-103(1 Jan 1976).

Rate constants for the deactivation of vibrationally excited hydroxyl radicals by the inert gases Ar, O_2, N_2, H_2, and D_2 were determined. Additionally the rate constants for the reaction $HO(\nu) + O_3$ yields products have been measured and found to decrease from 11×10^{-12} to 3.7×10^{-12} cm^3 $molecule^{-1}$ s^{-1} from $\nu = 9$ to $\nu = 4$. Hydroxyl radicals were generated in a large tank at low pressures from the reaction of hydrogen atoms and ozone. The radicals were formed in excited vibrational states (ν less than or equal to 9), and the excited radicals, $\nu = 4$ to 9, were observed by visible light emission from high overtone transitions. Vibrational populations and the rate constants for loss processes were deduced from observations over a wide range of wavelength and pressure fitted to a comprehensive model of the system. (5 fig, 7 tables, 55 references) (auth)

11198 Kinetics of radical decay in crystalline amino acids. II. High-temperature study. Joshi, A.; Johnson, R.H. (Florida State Univ., Tallahassee). *J. Phys. Chem.*; **80**: No. 1, 46-51(1 Jan 1976).

Radical decay in x-irradiated L-leucine, and DL-valine, L- and DL-alanine, and L-arginine hydrochloride was studied between 300 and 430°K. Free radical decay was observed to take place with two distinct rates: an initial short duration process having an activation energy of 18 kcal/mole and a second, slower process. In most cases, the fraction of radicals decaying by the faster process is the same as the very slow room-temperature decay previously observed. The major process has a 3—6-kcal/mole higher activation energy. There is no evidence of radical conversion in either the initial or the slower process. However, in at least two cases residual peroxy radicals were observed at the termination of the slower process. Both decays obey second-order rate laws. The peroxy radical in at least one case decayed by a second-order law also. Vacancy controlled bulk diffusion is proposed for the major process, and the initial process is thought to be a conformationally

aided bulk diffusion. It was observed that at any given temperature the spin concentration reaches a constant value. Increasing the temperature results in a second decay to a new constant value in a stepwise fashion. In the case of hydrated L-arginine hydrochloride and its partially deuterated derivative, the decay was found to be related to the dehydration process. A rapidly propagating radical transfer mechanism involving hydrogen abstraction is postulated for this decay process. (auth)

11199 Response to the comment: "Concerning the effect of an applied electric field on the dissociation of ion pairs into free ions". Mozumder, A. (Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). *J. Chem. Phys.*; **64**: No. 2, 912-913(15 Jan 1976).

A reply is made to comments G. R. Freeman, J. Chem. Phys. 64, 911 (1976) made on a recent paper A. Mozumder, J. Chem. Phys. 60, 4305 (1974) concerning Onsager's theory of the effect of an applied field on the dissociation of ion pairs in the free ions. (AIP)

11200 Pulse radiolytical investigation of the reversible reaction of biphenyl with the solvated electron in liquid ammonia. Farhataziz; Perkey, L.M. (Univ. of Notre Dame, IN). *J. Phys. Chem.*; **80**: No. 2, 122-126(15 Jan 1976).

From the measured solubility of biphenyl in liquid ammonia for the temperature range 21 to - 15.5°, 9.4 kcal mole^{-1} for the heat of solution and 30 cal deg^{-1} mole^{-1} for the entropy of solution for a 1 M standard state are calculated. Nanosecond pulse radiolysis of biphenyl solutions in liquid ammonia show that the reaction of e/sub am/$^-$ with biphenyl produces the biphenyl anion and it is reversible. From the values of the equilibrium constant (the equilibrium concentration of the biphenyl anion divided by the initial concentration of biphenyl and the equilibrium concentration of e$^-$/sub am) at 21.6 and 10.5°, - 20 kcal mole^{-1} for the heat of reaction and - 44 cal deg^{-1} mole^{-1} for the entropy of reaction for a 1 M standard state are calculated. The specific rate of the reaction of e$^-$/sub am/ with biphenyl is equal to 1.24 x 10/sup (12- 1600/2.3RT)/ for the temperature range 21.6 to - 75°. The extinction coefficient of the biphenyl anion at 0.403 μ, the wavelength of maximum absorption, is 3.1 x 10^4 M^{-1} cm^{-1} for the temperature range 23 to - 76.5°. The calculated values of the standard heat of formation of e$^-$/sub am/ and the entropy of e$^-$/sub am/ for a 1 M standard state are - 14 kcal mole^{-1} and 13 cal deg^{-1} mole^{-1}, respectively. (auth)

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

REFER ALSO TO CITATION(S) 11147

HOT-ATOM CHEMISTRY

REFER ALSO TO CITATION(S) 11168

11201 Ground electronic state of silylene. Zeck, O.F.; Su, Y.Y.; Gennaro, G.P.; Tang, Y.N. (Texas A and M Univ., College Station). *J. Am. Chem. Soc.*; **96**: No. 19, 5867-5973(18 Sep 1974).

Silylene-^{31}Si adds to 1,3-butadiene to give silacyclopent-3-ene-^{31}Si. Studies using nitric oxide as a scavenger demonstrate that the reacting silylene is present as 80 percent triplet and 20 percent singlet, while studies using neon as a moderator prove that the ground electronic state of silylene is a singlet. (auth)

PROPERTIES OF RADIOACTIVE MATERIALS

11202 (AI-ERDA--13156) **Decontamination and decommissioning criteria for use in design of new plutonium facilities.** Paschall, R.K. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Jun 1975. Contract AT(04-3)-701. 127p. Dep. NTIS $6.00.

Decontamination and decommissioning (D and D) criteria were assembled for use in designing new plutonium facilities. These criteria were gathered from literature searches and visits to many plutonium facilities around the country. The recommendations of reports and experienced personnel were used. Since total D and D costs can be millions of dollars, improved designs to facilitate D and D will result in considerable savings in cost and time and will help to leave the site for unrestricted future use after D and D. Finally, better design will reduce hazards and improve safety during the D and D effort. (auth)

11203 (PB—240962) **Environmental Radioactivity Laboratory intercomparison studies program, 1973—1974. Environmental monitoring series.** (National Environmental Research Center, Las Vegas, Nev. (USA)). Feb 1974. 27p. (EPA—680/4-73-001). NTIS $3.75.

The U. S. Environmental Protection Agency's intercomparison studies program for laboratories involved in environmental radiation measurements is described. The types of environmental samples distributed, the analysis required for each sample, the distribution schedule, and the statistical analysis and reporting of results are discussed. Instructions and application forms are included for laboratories desiring to participate in the program. This document is not a research report. It is designed for use by laboratories participating or desiring to participate in this quality assurance program. (GRA)

11204 Thermochemistry of uranium compounds. V. Standard enthalpies of formation of the monouranates of lithium, potassium, and rubidium. O'Hare, P.A.G.; Hoekstra, H.R. (Argonne National Lab., IL). *J. Chem. Thermodyn.*; **6**: 1161-1169(1974).

Enthalpies of reaction, ΔH/sub r/, of the monouranates of lithium, potassium, and rubidium with 1 mol dm^{-3} HCl were measured calorimetrically as —(41.77 +- 0.02), —(42.07 +— 0.05), and —(41.30 +- 0.05) kcal/sub th//mol, respectively. From these measurements, and auxiliary determinations of the enthalpies of solution in acid of the chlorides of lithium, potassium, and rubidium and of uranyl chloride, the standard enthalpies of formation of the uranates, ΔH°/sub f/, have been derived as —(463.31 +- 0.84), —(451.39) +- 0.83), and —(452.00 +— 0.85) kcal/sub th//mol for α—Li_2UO_4, K_2UO_4, and Rb_2UO_4, respectively. The values of ΔH/sub r/ and ΔH°/sub f/ differ significantly from those of the only previous study. (auth)

11205 Thermochemistry of uranium compounds. IV. Standard enthalpy of formation of sodium uranium(V) trioxide ($NaUO_3$). O'Hare, P.A.G.; Hoekstra, H.R. (Argonne National Lab., IL). *J. Chem. Thermodyn.*; **6**: 965-972(1974).

A pure carefully characterized sample of sodium uranium(V) trioxide, $NaUO_3$, has been reacted in a calorimeter containing an aqueous mixture of HCl and XeO_3. Based on the enthalpy of reaction, the standard enthalpy of formation, ΔH°/sub f/($NaUO_3$, c, 298.15 K), has been determined to be —(357.5 +- 0.8) kcal/sub th/ mol^{-1}. Derived thermodynamic data attest to the significant stability of $NaUO_3$. (auth)

11206 Simultaneous inhibition of thymidine degradation and stimulation of incorporation into DNA by 5-fluorodeoxy-uridine. Howland, G.P.; Yette, M.L. (Oak Ridge National Lab., TN). *Plant Sci. Lett.*; **5**: 157-162(1975).

Cultured plant cells degrade exogenously supplied thymidine. 5-Fluorodeoxyuridine (FdUrd) can be used to inhibit this degradation while at the same time enhancing thymidine (dThd) incorporation into DNA. If ^{14}C- or ^{3}H-labeled dThd is used, the improvement in DNA labeling which results permits detection of DNA synthesis in freshly isolated protoplasts, as well as other sensitive measures of DNA metabolism in plant cells. (auth)

11207 Thermochemistry of uranium compounds. VI. Standard enthalpy of formation of cesium diuranate ($Cs_2U_2O_7$). Thermodynamics of formation of cesium and rubidium uranates at elevated temperatures. O'Hare, P.A.G.; Hoekstra, H.R. (Argonne National Lab., IL). *J. Chem. Thermodyn.*; **7**: 831-838(1975).

Cesium diuranate, $Cs_2U_2O_7$, was reacted with 1 mol dm^{-3} HCl in a solution calorimeter. The enthalpy of reaction, —(46087 +- 102) cal/sub,th/ mol^{-1}, leads to a standard enthalpy of formation, ΔH°/sub f/($Cs_2U_2O_7$, c, 298.15 K), of —(754.3 +— 1.06)kcal/sub th/ mol^{-1}. Thermodynamics of the Cs + U + O and Rb + U + O systems are discussed with particular emphasis on the formation of cesium and rubidium uranates and diuranates in nuclear reactor fuel. Formation of the monouranates is expected to predominate, although diuranates are also predicted to form, but in rather low concentrations. (auth)

11208 Physical adsorption of 1,1,1-trichloroethane on uranium dioxide. Stakebake, J.L. (Dow Chemical, Golden, CO). *J. Catal.*; **36**: 463-470(1975).

Adsorption isotherms for 1,1,1-trichloroethane adsorption on uranium dioxide were obtained gravimetrically in the temperature range 0 to 30°C. Adsorption data were evaluated using the BET and Clausius—Clapeyron equations and the potential theory of adsorption. The heat of adsorption was found to vary between 12 and 8 kcal/mole, depending upon the coverage. Using the BET equation the size of the adsorbed CH_3CCl_3 molecule was calculated to be 33 +- 5 A^2. (auth)

11209 Nonaqueous actinide hydride dissolution and production of actinide β-diketonates. Crisler, L.R. (to U.S. Energy Research and Development Administration). US Patent 3,919,273. 11 Nov 1975. Filed date 23 Aug 1974. 6p.

PAT-APPL-499,957.

Actinide beta-diketonate complex molecular compounds are produced by reacting a beta-diketone compound with a hydride of

the actinide material in a mixture of carbon tetrachloride and methanol. (auth)

11210 Nonaqueous method for dissolving lanthanide and actinide metals. Crisler, L.R. (to U.S. Energy Research and Development Administration). US Patent 3,919,274. 11 Nov 1975. Filed date 23 Aug 1974. 6p.

PAT-APPL-499,960.

Lanthanide and actinide beta-diketonate complex molecular compounds are produced by reacting a beta-diketone compound with a lanthanide or actinide element in the elemental metallic state in a mixture of carbon tetrachloride and methanol.

11211 Preparation of uranium compounds. Mercier, H.; Jean, R. (to Pechiney Ugine Kuhlmann). US Patent 3,920,788. 18 Nov 1975. Priority date 28 Sep 1971, France. 10p.

A method for the production of uranium compounds in a high state of purity comprises the steps of contacting a uranium-bearing material with aqueous sulfuric acid, adjusting the ratio of water and sulfuric acid in the resulting leach solution to within the range of 0.16 to 0.26 to precipitate impurities from the first leach solution, diluting a second leach solution after removal of the precipitate formed to adjust the ratio of water and sulfuric acid to within the range of 0.35 to 0.50. (auth)

11212 Synthesis of pentafluorides. Asprey, L.B.; Paine, R.T. Jr. (to U.S. Energy Research and Development Administration). US Patent 3,929,601. 30 Dec 1975. Filed date 26 Mar 1974. 4p.

PAT-APPL-454,983.

The reactions of uranium, molybdenum, rhenium, osmium and iridium hexafluorides with hydrogen gas in the presence of ultraviolet radiation or with silicon powder in an anhydrous HF slurry provide especially useful, high yield syntheses of pure pentafluorides.

11213 Infrared spectra of matrix-isolated UO_2^+ and NO_2^-. Green, D.W.; Gabelnick, S.D.; Reedy, G.T. (Chemical Engineering Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439). *J. Chem. Phys.*; **64**: No. 4, 1697-1705(15 Feb 1976).

The reactions of UO and UO_2 with NO and NO_2 have been studied by infrared spectroscopy using the matrix isolation technique. Codeposition of vaporized UO and UO_2 with NO_2 and with NO gases in an argon matrix at 14 K resulted in the production of the UO^+_2 molecular ion paired with either a NO^-_2 or NO^- anion. Three different reactions have been observed to yield a UO^+_2 cation product: (1) UO_2+NO_2, (2) UO_2+NO, and (3) $UO+NO_2$. Infrared absorption frequencies in the range 1150—1190 cm^{-1} have been measured and interpreted as the stretching modes of bent (bond angle = 109degree) $N^{16}O^-_2$, $N^{16}O^{18}O$, and $N^{18}O^-_2$ ions paired with UO^+_2. Infrared absorption frequencies in the range 770—900 cm^{-1} have been measured and interpreted as the stretching modes of linear $U^{16}O^+_2$, $U^{16}O^{18}O^+$, and $U^{18}O^+_2$ paired with either NO^- or NO^-_2. (AIP)

RADIOISOTOPE PRODUCTION

REFER ALSO TO CITATION(S) 10328, 11169

11214 Gas production apparatus and method. Winsche, W.E.; Miles, F.T.; Powell, J.R. (to U.S. Energy Research and Development Administration). US Patent Application 560,430. Filed date 20 Mar 1975. 13p.

This invention relates generally to the production of gases, and more particularly to the production of tritium gas in a reliable long operating lifetime systems that employs solid lithium to overcome the heretofore known problems of material compatibility and corrosion, etc., with liquid metals. The solid lithium is irradiated by neutrons inside low activity means containing a positive pressure gas stream for removing and separating the tritium from the solid lithium, and these means are contained in a low activity shell containing a thermal insulator and a neutron moderator. (auth)

11215 Radioactive material generator. Czaplinski, T.V.; Bolter, B.J.; Heyer, R.E.; Bruno, G.A. (to E.R. Squibb and Sons, Inc.). US Patent 3,920,995. 18 Nov 1975. Filed date 20 May 1974. 10p.

A radioactive material generator includes radioactive material in a column, which column is connected to inlet and outlet conduits, the generator being embedded in a lead casing. The inlet and outlet conduits extend through the casing and are topped by pierceable closure caps. A fitting, containing means to connect an eluent supply and an eluate container, is adapted to pierce the closure caps. The lead casing and the fitting are compatibly contoured such that they will fit only if properly aligned with respect to each other. (Official Gazette)

ENGINEERING

GENERAL ENGINEERING

11216 (SAND—75-0426) **Sandia technology, Autumn 1975.** Weber, J.; Mead, P. (eds.). (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1976. Contract AT(29-1)-789. 33p. Dep. NTIS $5.00.

A separate abstract was prepared for each of the six sections for ERDA Energy Research Abstracts (ERA). In addition, two sections were abstracted for NSA. (RCK)

11217 (SAND—75-0426, pp 24-27) **Stability of liquid films in transpiration-cooling.** Saric, W.S.; Touryan, K.J. Feb 1976.

In Sandia technology, Autummn 1975.

Transpiration cooling can be used to protect a reentry vehicle from the effects of aerodynamic heating. Stability characteristics of liquid films on transpiration-cooled hypersonic vehicles can be predicted by analytical models.

11218 (SAND—76-5186) **Effects of He-binder interactions on the viscoelastic properties of PETN/ and RDX/Sylgard-182 formulations.** Holovka, J.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 6p. (CONF-760412—1). Dep. NTIS $3.50.

From Conference on compatibility of material w;explosives propellant; Philadelphia, Pennsylvania, United States of America [USA] (28 Apr 1976).

The dynamic mechanical behavior of PETN/Sylgard-182 (80:20) and RDX/Sylgard-182 (85:15) was investigated using a free torsional pendulum. Both materials exhibited the viscoelastic properties typical of elastomers. Transitions were identified for PETN/Sylgard at -100°C, 3°C(Tg), and 130°C and for RDX/Sylgard at -60°C(Tg) and 150°C. The higher Tg for PETN/Sylgard may result from intermolecular bonding between PETN and the silicone binder.

11219 (UCID—16996) **Basic manual for the use of automatically programmed tools.** Spies, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jan 1976. Contract W-7405-Eng-48. 62p. Dep. NTIS $5.45.

This manual was designed to supplement the lectures of a ten-hour course in the basic usage of automatically programmed tools (APTs). This course is given to many draftsmen, designers, engineers, and machine shop personnel at Lawrence Radiation Laboratory to acquaint them with basic numerical control and programming language use. Although only a primer on the subject, this manual provides almost all the available means of defining points, lines, and circles, plus many of the statements used in simpler part programs. (RWR)

11220 Lifting parachute. Rychnovsky, R.E. (to U.S. Energy Research and Development Administration). US Patent 3,927,850. 23 Dec 1975. Filed date 31 Dec 1974. 8p.

PAT-APPL-537,810.

The design is given of a parachute which may be dropped and deployed at high speeds and which will lift stores being carried by the parachute to an altitude near or above the initial drop altitude. A canopy is formed from concentric, circumferentially arranged ribbons, in which the rearward facing portions of the canopy have a greater porosity than the remaining portions of the canopy. The greater porosity portion may be formed with ribbons narrower than the other ribbons or preferably with ribbons which assume an outwardly slanted relationship with respect to the normal inflated canopy curvature.

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 10357, 10504, 10960, 11404

11221 (LMEC-TDR—75-14) **SPTF thermal insulation performance test.** Armstrong, G.R. (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 1975. Contract E(04-3)-700. 64p. AT.

The results of a test program conducted at the Liquid Metal Engineering Center (LMEC) to determine the performance characteristics of the thermal insulation used on the Class A piping in the Sodium Pump Test Facility (SPTF) are described. The insulation was installed on a section of 16-in. pipe and operated for 1273 hr at 1050°F. Post-test examination of the assembly did not reveal any evidence to indicate that the insulation was detrimental to the stainless steel piping.

11222 (RT/ING—(75)14) **Finite element method applied to bidimensionally stressed structures.** Cesari, F.; Gheduzzi, P. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jul 1975. 330p. (In Italian). Dep. NTIS (US Sales Only) $10.00.

A two-dimensional stress analysis of two plate elements has been performed by the finite element method: R-12 rectangular element nonconforming and T-21 triangular element conforming. Results from analyses of the R-12 and T-21 elements are compared from the convergence view point.

11223 (SAND—74-0086) **Sandia Laboratories technical capabilities: electronics.** Lundergan, C.D. (ed.). (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 17p. Dep. NTIS $3.50.

This report characterizes the electronics capabilities at Sandia Laboratories. Selected applications of these capabilities are presented to illustrate the extent to which they can be applied in research and development programs. (auth)

11224 (SAND—74-0440) **Aeroballistic and mechanical design and development of the Talos-Terrier-Recruit (TATER) rocket system with flight test results.** Rollstin, L.R.; Fellerhoff, R.D. (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1976. Contract AT(29-1)-789. 120p. Dep. NTIS $6.50.

The aerodynamic and mechanical design aspects and the performance analysis for the TATER rocket system are discussed. The TATER is a three-stage, solid-propellant rocket system capable of boosting a 70-lb recoverable payload to velocities of 10,500 to 11,000 ft/s in approximately 12 seconds from launch with a maximum velocity altitude variation of 10,000-30,000 ft on an ascent trajectory.

11225 (SAND—75-0221) **Acceleration of flyer plates by electrically exploded foils.** Stanton, P.L. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 41p. Dep. NTIS $5.00.

Metal foils, exploded by a pulse of high density electric current, can be used to accelerate thin plastic flyers to velocities of 8 km/s or greater. The behavior of these devices has been investigated analytically and experimentally. The results of hydrodynamic computer code simulations are shown to be in good agreement with experimental measurements of the flyer velocity. (auth)

11226 (SAND—75-0610) **Utilization of fiber optics for radiant energy transfer.** Hohimer, J.P. (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1976. Contract AT(29-1)-789. 42p. Dep. NTIS $4.00.

This report considers the utilization of fiber optics to collect and transfer the radiant energy emitted by a pulsed flashlamp or laser. Such a system could be used for a variety of illumination and optical pumping applications including the optical initiation of high explosives. From an analysis of the electrical to optical energy conversion efficiencies of these optical sources and the light collection and transmission efficiencies of commercially available optical fibers, it is estimated that a 13.1 percent overall energy conversion efficiency could be attained at the output end of a one meter long optical fiber bundle using a critically damped xenon short-arc flashlamp as the optical source. The overall energy conversion efficiencies of the other source-fiber combinations considered are: 8.6 percent for a critically damped linear xenon flashlamp, 2.0 percent for a long-pulse multimode Nd:YAG laser, 0.7 percent for a multimode Rhodamine 6G dye laser, and 0.5 percent for a Q-switched multimode Nd:YAG laser. Although the overall energy conversion efficiencies of the critically damped flashlamps greatly exceed those of lasers, it is shown that certain other factors generally determine the optical source type best suited to a particular application. These factors are the total radiant energy available at the output end of an optical fiber bundle of a specified cross-sectional area; and the spectral, temporal, and spatial distribution of this energy. In particular, Q-switched solid-state lasers can provide the high energy short-time-duration light pulses required for the shock wave initiation of secondary high explosives. (auth)

11227 (UCRL—13667) **Development of a design basis tornado and structural design criteria for Lawrence Livermore Laboratory's Site 300.** McDonald, J.R.; Minor, J.E.; Mehta, K.C. (McDonald, Mehta and Minor, Consulting Engineers, Lubbock, Tex. (USA)). Nov 1975. 65p. Dep. NTIS $4.50.

For Univ. of California, Livermore.

Criteria are prescribed and guidance is provided for professional personnel who are involved with the evaluation of existing buildings and facilities at Site 300 near Livermore, California to resist the possible effects of extreme winds and tornadoes. The development of parameters for the effects of tornadoes and extreme winds and guidelines for evaluation and design of structures are presented. The investigations conducted are summarized and the techniques used for arriving at the combined tornado and extreme wind risk model are discussed. The guidelines for structural design methods for calculating pressure distributions on walls and roofs of structures and methods for accommodating impact loads from missiles are also presented. (auth)

11228 (UCRL—50028-75-2, pp 39-45) **Computer simulations group.** 1975.

In H-Division quarterly report, April—June 1975.

This group is responsible for calculations in the general area of solid mechanics. Work currently underway includes long-rod-penetrator mechanics, armor design, three-dimensional analysis of a gas turbine stator blade, definition of missile-silo environment from penetrating nuclear weapons, and aircraft-hangerette vulnerability. Code development associated directly with this work includes modifications of finite difference and finite element computer programs and the companion graphics software. (auth)

11229 (Y—2014) **High-stiffness graphite fiber/epoxy composite grinding quill for a vertical turning machine tool.** Kovach, L.; Knight, C.E. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 15p. Dep. NTIS $4.00.

Modification of an Ex-Cell-O vertical turning machine into a precision contour grinder was effected by the use of a graphite fiber/epoxy composite as the structural support (termed a Quill) for the grinding head.

11230 **Comprehensive technique for calculating particulate control device efficiencies utilizing particle size distributions.** Vatavuk, W.M. (Environmental Protection Agency, Research Triangle Park, NC); Theodore, L. pp 18-189 of In Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).

From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).

See CONF-741179—.

A generalized mathematical technique is developed to calculate the overall collection efficiency of particulate control devices. Equipment operating parameters and the size distribution of the particles in the inlet gas stream are used in the calculation. The technique is successively applied to efficiency calculations for settling chambers, cyclones, venturi scrubbers, and electrostatic precipitators, all treating a stream exhibiting an exponential particle size distribution. Extension of this method is made to encompass control devices operated in series. Specific examples are also included to illustrate the technique when it is applied to single and multiple devices. Advantages and disadvantages to the technique are also discussed.

11231 **Key-and-keyway coupling for transmitting torque.** Blue, S.C.; Curtis, M.T.; Orthwein, W.C.; Stitt, D.H. (to U.S. Energy Research and Development Administration). US Patent 3,920,343. 18 Nov 1975. Filed date 13 Nov 1974. 6p.

PAT-APPL-523,377.

The design of an improved key-and-keyway coupling for the transmission of torque is given. The coupling provides significant reductions in stress concentrations in the vicinity of the key and keyway. The keyway is designed with a flat-bottomed u-shaped portion whose inboard end terminates in a ramp which is dished transversely, so that the surface of the ramp as viewed in transverse section defines an outwardly concave arc.

11232 **Volumetric dispenser for small particles from plural sources.** Bradley, R.A.; Miller, W.H.; Sease, J.D. (to U.S. Energy Research and Development Administration). US Patent 3,926,344. 16 Dec 1975. Filed date 20 Jun 1974. 6p.

PAT-APPL-481,422.

Apparatus is described for rapidly and accurately dispensing measured volumes of small particles from a supply hopper. The apparatus includes an adjustable, vertically oriented measuring tube and orifice member defining the volume to be dispensed, a ball plug valve for selectively closing the bottom end of the orifice member, and a compression valve for selectively closing the top end of the measuring tube. A supply hopper is disposed above and in gravity flow communication with the measuring tube. Properly sequenced opening and closing of the two valves provides accurate volumetric discharge through the ball plug valve. A dispensing system is described wherein several appropriately sized measuring tubes, orifice members, and associated valves are arranged to operate contemporaneously to facilitate blending of different particles.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 10433, 10452, 10453, 10454, 10455, 10456, 10457, 10917, 10993, 11313, 11349, 12097, 12193, 12194, 12221, 12222, 12230, 12277

11233 (COM—75-10472-04) **Superconducting devices and materials. A literature survey issued quarterly, October—December 1975. Issue No. 75-4.** Olien, N.A. (comp.). (National Bureau of Standards, Boulder, Colo. (USA)). 1975. 128p. National Bureau of Standards, Boulder, CO.

Highlights of the literature on superconducting devices and materials are briefly reviewed. The review is followed by an extensive bibliography of approximately 2000 references (no abstracts). An author index is included. (TFD)

11234 (SAND—75-0604) **SSWL and BWL: finite element models of compressed magnetic field current generators.** Tucker, T.J.; Leeman, J.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 82p. Dep. NTIS $6.00.

Documentation is presented for two new computer codes modeling the behavior of compressed magnetic field current generators. Code output results for the typical generator configurations are presented and compared to experimental results. (auth)

11235 Superconductive microstrip exhibiting negative differential resistivity. Huebener, R.P.; Gallus, D.E. (to U.S. Energy Research and Development Administration). US Patent 3,916,432. 28 Oct 1975. Filed date 17 May 1974. 6p.

PAT-APPL-470,898.

A device capable of exhibiting negative differential electrical resistivity over a range of values of current and voltage is formed by vapor-depositing a thin layer of a material capable of exhibiting superconductivity on an insulating substrate, establishing electrical connections at opposite ends of the deposited strip, and cooling the alloy into its superconducting range. The device will exhibit negative differential resistivity when biased in the current-induced resistive state.

11236 Superconducting tunable-diaphragm transducer for sensitive acceleration measurements. Paik, H.J. (Department of Physics, Stanford University, Stanford, California 94305). *J. Appl. Phys.*; **47**: No. 3, 1168-1178(Mar 1976).

A very sensitive resonant superconducting accelerometer was developed as a component of a cryogenic gravitational-radiation detector. The device consists of a superconducting test mass and superconducting coils carrying a persistent current. The displacement of the test mass modulates the inductances of the coils and generates an ac magnetic field which is detected by a Josephson-junction magnetometer. The restoring force provided by the magnetic field is used to tune the resonant frequency of the transducer. The expected sensitivity of the system is better than 10^{-15}g/subE//z $)^{2}$ (g/subE/ =9.8 m/s ^{2}) when used to detect accelerations at frequencies lower than 50 Hz. The system has been thoroughly tested and is being used to detect small accelerations of a gravitational-wave antenna caused by the Brownian motion and other external disturbances. When used as a resonant displacement sensor in a gravitational-wave detector cooled to 3 mK, this transducer is capable of converting a displacement of $4x10^{-20}$ m at 1 kHz into an electrical signal detectable with unity signal-to-noise ratio for 1-Hz bandwidth. The gravitational-radiation-flux sensitivity implied by this is 0.1 erg/cm^{2} Hz. This will make not only the observation of expected galactic events possible, but will allow one to extend the scope of observation beyond the Milky Way. The system can be modified to make a sensitive gravity gradiometer. The device in various applications is discussed and the theory of transducer energy coupling, frequency tuning, and parameter optimization is presented. Some experimental results confirming the theory are reported. Included are data showing the temperature dependence of the Q of a niobium diaphragm and the measurement of the low-frequency background acceleration of a magnetically levitated gravitational-wave antenna. (AIP)

PROTECTIVE STRUCTURES AND EQUIPMENT

REFER ALSO TO CITATION(S) 10246, 10247, 10265, 10334

11237 (DPSPU—75-30-15) **Respiratory and protective equipment at a large nuclear facility.** Zippler, D.B. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Plant). Dec 1975. Contract AT(07-2)-1. 15p. (CONF-760403—1). Dep. NTIS $3.50.

From Conference on control of hazardous material spills; New Orleans, Louisiana, United States of America *USA* (27 Apr 1976).

A variety of personal protective equipment is used in a large nuclear facility to protect employees against both nuclear and ordinary industrial materials. Equipment requirements are based on risk evaluation and may range from a minimum of shoe covers to whole body protection by air-supplied plastic suits. Types of equipment are listed and one-year costs are given. Criteria for evaluating and compartmentalizing risks are discussed. Air-supplied suits and hoods are discussed in detail. (auth)

11238 (PB—241105) **Improved mine rescue breathing apparatus. Final report, Jul 1972-Oct 1974.** Ryback, W.H. (Kinergetics, Inc., Tarzana, Calif. (USA)). 24 Oct 1974. Contract H0220045. 46p. NTIS $3.75.

The objective of the research was to design, build, and test a self-contained cryogenic breathing apparatus suitable for a 4-hour period of mine rescue work and weighing 20 pounds or less. The program led to the development of a 28-pound breathing apparatus. The system is unique in that an oxygen liquefier and storage dewar are integral to the apparatus. Lithium hydroxide is used to absorb CO_2. Liquid level is sensed by an electronic device sensitive to total amount of liquid present, regardless of dewar orientation. The breathing apparatus failed to receive prototype approval from the National Institute of Occupational Safety and Health and Mining Enforcement and Safety Administration. The device would require considerable additional development to be brought to a successful preproduction prototype. (GRA)

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 11393

11239 (SAND—75-8300) **Welded rupture disc assemblies for use in Tritium Research Laboratory.** Faltings, R.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 11p. Dep. NTIS $3.50.

Welded rupture disc assemblies were investigated and developed in various ranges for probable use by experimenters in their activities in the Tritium Research Laboratory at Sandia Laboratories, Livermore. This study indicates that currently welded rupture disc assemblies with appropriate testing and installation by certified pressure installers may be used in pressure systems in the Tritium Research Laboratory and other areas at SLL. (auth)

11240 Radioactive waste: plant to disposal. Greco, J.; Ingwersen, J.L. (Tennessee Valley Authority, Chattanooga). *Proc. Am. Power Conf.*; **37**: 205-212(1975).

From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

See CONF-750469—.

The design and operation of the radioactive waste-handling system for the Browns Ferry Nuclear Plant are presented. Studies were made of casks and support equipment and services, including trailers, tractors, disposal ground services, liners, liner filters, and liner level instrumentation. The advantages of a utility-owned cask and of casks from a contracted service are weighed, and it was determined that only frequent shipments of spent condensate cleanup resin would make a TVA-owned cask economically feasible. (PMA)

11241 218-neutron-group master cross-section library for criticality safety studies. Ford, W.E. III; Westfall, R.M.; Webster, C.C. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; **22**: 290-291(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

11242 Procedure for determining broad-group energy structure for criticality safety calculations. Westfall, R.M.; Plaster, D.M.; Ford, W.E. III. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; **22**: 291-292(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

11243 Effect of gadolinium on criticality of U + Pu solutions. Lloyd, R.C. (Battelle Northwest Labs., Richland, WA). *Trans. Am. Nucl. Soc.*; **22**: 292(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

11244 Cross sections for criticality safety computations. Clark, H.K. (Savannah River Lab., Aiken, SC). *Trans. Am. Nucl. Soc.*; **22**: 297-298(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

11245 Comments on the use of the Monte Carlo method for criticality calculations. Whitesides, G.E. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; **22**: 298-299(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

11246 **Remarks on surface density and density analog representation of array criticality.** Thomas, J.T. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; **22**: 299-300(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

SHIPPING CONTAINERS

REFER ALSO TO CITATION(S) 11240

11247 (DPSPU—73-124-1) **Safety analysis report: packages cobalt-60 shipping cask (packaging of radioactive and fissile materials.** Evans, J.E.; Langhaar, J.W. (comps.). (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Jul 1973. Contract AT(07-2)-1. 211p. Dep. NTIS $7.75.

Safety Analysis Report DPSPU-73-124-1 replaces DPSPU-69-124-1 and Supplement 1 to permit shipment of 350,000 curies of ^{60}Co (maximum) in cobalt-60 shipping casks in compliance with 10 CFR Part 71, Packaging of Radioactive Materials for Transport. (auth)

11248 (SAND—75-0426, pp 28-31) **Accident-resistant containers for nuclear weapons.** Berry, R.E. Feb 1976.

In Sandia technology, Autumn 1975.

To prevent detonation of high explosives in accidents during transportation of nuclear weapons, a practical technology for design of accident-resistant containers has been developed.

LASERS

REFER ALSO TO CITATION(S) 10955, 11706, 11719, 11723, 11759, 12252, 12253, 12254

11249 (AD/A—005294) **Laser Energy Evaluator (LEE): laboratory and field tests. Final report, Oct 1972-Jun 1974.** Labo, J.A.; Marston, D.R.; Laudieri, P.C. (School of Aerospace Medicine, Brooks AFB, Tex. (USA)). Dec 1974. 20p. (SAM-TR—74-50). NTIS $3.25.

The Laser Energy Evaluator (LEE) is intended for use by Air Force laser safety personnel to: (1) confirm Safe Eye Exposure Distance (SEED) calculations by direct measurement, (2) test for possible hazardous reflections from an operating laser system, and (3) facilitate laser hazard surveys as required by AFR 161-24. The calibration tests showed that the LEE measured laser output intensities on the same order as the Permissible Exposure Levels to within +- 10 percent of each energy or power scale reading. The user tests show that the LEE could be used as a field device, but has some inherent limitations. (GRA)

11250 (AD/A—006034) **Spectral emittance measurements on some laser window materials. Physical sciences research papers.** Skolnik, L.H. (Air Force Cambridge Research Labs., L.G. Hanscom Field, Mass. (USA)). 2 Dec 1974. 22p. (AFCRL-PSRP—615; AFCRL-TR—74-0590). NTIS $3.25.

A cryogenic emittance spectrometer for measuring absorption coefficients in the 2.5 to 14 micrometer region is described. The spectrometer is modular in design and uses a liquid nitrogen-cooled circular variable filter (CVF) as the monochromator element. By using an electrically heated sample holder, temperature as well as frequency dependence of the absorption coefficient is obtained. Some representative spectra of high resistivity GaAs, CVD ZnSe, and RAP KCl are presented. GaAs appears to be at least partially dominated by multiphonon absorption near 10.6 micrometers, while both ZnSe and KCl show intrinsic loss mechanisms in this region at room temperature. (GRA)

11251 (AD/A—006101) **Investigate material systems for mirrors used in high power CO and CO_2 lasers. Final technical report.** Stewart, R.W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1974. Contract N00123-72-C-2215. 79p. NTIS $4.75.

See also report dated Aug 1973, AD—769103.

This report is aimed at demonstrating the viability of a mirror structure concept formed by sputter deposited materials. The mirror concept would be used in high energy CO, CO_2, and other infrared laser systems at the infrared wave length of 10.6 μ. Sputtered deposits of Cu-1 vol percent SiC on a variety of metal substrates provided surfaces that could be reproducibly polished using conventional techniques to an rms roughness of 20 A or less. Sputter-deposited germanium and CdTe were found to have optical properties near those of bulk material. Sputter deposition of quarter-wavelength reflectivity enhancement coatings therefore appears feasible. The results of limited laser damage testing were exceptional considering that there was not time to optimize material properties. (GRA)

11252 (AD/A—006197) **Problems of the gamma ray laser. Report for 1 May 1973-1 Jun 1974.** Baldwin, G.C. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA)). Aug 1974. 145p. NTIS $5.75.

This report is addressed to the problem of the state-of-the-art of gamma ray laser development. It is intended to identify the various disciplines and specific research areas which can best contribute to resolving the question of "graser" feasibility. Topics discussed include the following: the basic mechanisms of laser action; gamma ray emission from nuclear isomers; the resonance cross section; nonresonant absorption; photon kinetics; inhomogeneous line breadths; and problems of pumping. (GRA)

11253 (AD/A—007838) **Development of chalcopyrite crystals for nonlinear optical applications. Final report, 30 Jun 1972-31 Oct 1974.** Begley, R.F.; Byer, R.L.; Chemla, D.S.; Choy, M.M.; Herbst, R.L. (Stanford Univ., Calif. (USA). Microwave Lab.). 1 Dec 1974. Contract F33615-72-C-2011. 144p. (ML—2387). NTIS $5.75.

This final report summarizes recent progress in the growth of three chalcopyrite crystals, $CdGeAs_2$, $AgGaSe_2$, and $AgGaS_2$. Recent applications of these crystals to the generation of tunable infrared radiation have been more actively pursued as a result of a number of important requirements for tunable sources. The treatment includes a discussion of third and fourth harmonic generation. Recent work in $AgGaSe_2$ for infrared generation by mixing is presented as a reprint in Appendix III. Also included in Appendix IV is a preprint of a paper describing a new model for the calculation of second order nonlinear susceptibilities. The Bond Orbital Model is a physically descriptive model which should prove useful for estimating nonlinear properties of new semiconducting crystal compounds. The accomplishments of this program have been the growth and characterization of the chalcopyrite crystals $CdGeAs_2$, $AgGaSe_2$, and $AgGaS_2$ and their application to the generation of infrared radiation by second, third, and fourth harmonic generation, and by mixing over the spectral range from 1 to 18 μ. (GRA)

11254 (AD/A—007975) **Ir window studies. Final report, 1 Jun 1972-31 Aug 1974.** Kroger, F.A.; Marburger, J.H. (University of Southern California, Los Angeles (USA). Electronic Sciences Lab.). 15 Sep 1974. Contract F19628-72-C-0275. 112p. NTIS $5.25.

See also report dated 15 Jun 1974, AD/A—003393.

Topics discussed include Epitaxial growth of semi-insulating GaAs from Ga solutions; Optimization of alkali halide window materials; Growth of crystals for infra red window research; Fabrication of polycrystalline IR window materials; Mechanical behavior of III-V and II-VI compounds; Dielectric constant measurements; Study of defects in II-VI compounds; Theoretical studies of absorption mechanisms in IR window materials; Investigation of infrared loss mechanisms in high resistivity GaAs; Alkali halide surface studies with acoustic probe techniques; Absorption studies of CdTe and ZnSe; Characterization of optical performance of IR window systems; and Laser damage studies. (GRA)

11255 (AD-A—007976) **High radiance AlGaAs laser illuminator. Final report, Jan 1973-Mar 1974.** Barratt, W.W.; O'Hara, L.S. (RCA Advanced Technology Labs., Burlington, Mass. (USA)). Nov 1974. Contract F33615-73-C-1204. 72p. NTIS $4.25.

The scope of the program was to conduct research and development of a High Radiance Aluminum Gallium Arsenide (AlGaAs) Laser Illuminator and to fabricate, test and deliver an experimental model of the system developed. This development was aimed at a reduction in the exit aperture, size, and weight of the projection optical system required for a narrow field, high power, liquid nitrogen (LN2) cooled illuminator used in conjunction with gated Low Light Level TV systems. In order to achieve these goals, the development was aimed at producing an improvement in the average brightness of the injection laser array. This was accomplished by reducing the beam divergence from the injection laser diode arrays through use of a micro-cylindrical lens method. Details of this method, its application to an array and optical integrator assembly and incorporation into an illuminator system are covered. (GRA)

11256 (AD/A—008164) **Spectroscopic and infrared measurements on cw HF(DF) chemical lasers. Interim report.** Kwok, M.A.; Giedt, R.R.; Cross, E.F. (Aerospace Corp., El Segundo, Calif. (USA)). 28 Feb 1975. Contract F04701-74-C-0075. 40p. NTIS $3.75.

The supersonic, free-jet medium of a 10 to 15 kW, HF/DF chemical laser is studied. Results from a remotely controlled spectrograph that scans rapidly, spatially, and spectrally are described; observations from an ir vidicon system are also given. The laser system includes two types of plenum gas heater: arc and com-

bustor; and two types of nozzle bank: split and axisymmetric. The spectrograph measures the HF 3-0 P-branch emission, from which HF(3) number density along the line-of-sight N3L and rotational temperature T(R) are deduced at a large number of spatial positions. The data can be given as three types: (1) spatial scans transverse to the flow, (2) scans parallel to the flow, and (3) data at fixed position. Various interpretations concerning the medium result from the three types of data. (GRA)

11257 (AD/A—008495) **Selection, synthesis, growth and characterization of potential 10.6 micron window materials. Final report, 16 Aug 1971-16 Aug 1974.** White, W.B.; Roy, R. (Pennsylvania State Univ., University Park (USA). Materials Research Labs.). 15 Dec 1974. Contract F19628-71-C-0232. 24p. NTIS $3.25.

A systematic search has been made for ternary and more complex materials that could serve as new 10.6 μ ir windows. A literature survey of chalcogenide materials allowed the sorting of more than 1000 ternary compounds into structurally-related families. From these were selected the spinel structure, the Th_3P_4 structure, the calcium ferrite structure, and the As—Sb—Bi—Pb—Ag—S system for experimental investigation. On the order of 100 compounds were synthesized and their melting behavior, stability under atmospheric ambients, and vibrational spectra were determined. A systematic investigation of all known alkali halide systems reveals no ternary compounds or combination of binary compounds that appear to be superior to the alkali halide window materials already in use. Complex oxides of bismuth with other metals, most importantly lead, are cubic but have vibrational frequencies too high for their consideration as ir windows. (GRA)

11258 (AD/A—008571) **Photodissociation dye laser. Semiannual technical report, 1 Oct 1974-1 Mar 1975.** Kasdan, A. (Exxon Research and Engineering Co., Linden, N.J. (USA). Government Research Lab.). Apr 1975. Contract N00014-73-C-0048. 37p. NTIS $3.75.

The photodissociation dye laser (PDL) program is an effort to develop a new class of tunable liquid lasers operating in the visible region of the spectrum. In the PDL scheme, laser action occurs between an excited electronic state and the ground electronic state of radicals produced by the photodissociation of specific classes of molecules in solution. Five promising PDL molecules have been synthesized and their absorption spectra characterized. A pulsed tunable uv source has been assembled to investigate their fluorescence characteristics. Hexaphenylethane has been identified as the most promising PDL candidate for an initial study. Triphenylmethyl radical fluorescence has been observed in the hexaphenylethane system. (GRA)

11259 (COO—2723-1) **Exploratory study of metal vapor lasers operating in the ultra-violet at kilowatt power levels. Technical progress report, June 1, 1975—May 1, 1976.** Collins, G.J. (Colorado State Univ., Fort Collins (USA)). Mar 1976. Contract E(11-1)-2723. 6p. Dep. NTIS $3.50.

Three laser research programs are proposed: (1) to find new laser systems in the wavelength region between 2000 and 4500 A; (2) to attempt scaling lasers to high output power; and (3) to focus research on metal vapor laser systems which have promise of high efficiency. Twenty-eight new laser transitions from Cu II spanning the wavelength region from 2486 to 7988 A have been observed. A list of papers and conferences are given that summarize the metal vapor laser research. (TFD)

11260 (LA-UR—76-368) **Generation and amplification of nanaosecond duration multiline hf laser pulses.** Getzinger, R.L.; Ware, K.D.; Carpenter, J.P. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 5p. (CONF-760318—1). Dep. NTIS $3.50.

From Meeting of Society of Photo-Optical Instrumentation Engineers; Palos Verdes Estates, California, United States of America *USA* (22 Mar 1976).

High-power, fast-rising pulses of hydrogen fluoride laser energy suitable for laser-fusion target interaction experiments can in principle be generated by directing an electro-optically shuttered oscillator pulse through one or more electron-beam driven amplifiers. A three-stage HF master oscillator-power amplifier (MOPA) configuration was constructed and tested using SF_6-C_2H_6 in which an E-O generated 4-ns-FWHM pulse was amplified in an electron-beam-excited third stage and subsequently isolated with a Brewster angle splitter. Independent experiments in which a 100-ns-FWHM pilot pulse interacted with the power amplifier demonstrated for the first time complete extraction of the available laser energy. These two results provide strong evidence that with upgrading to H_2-F_2, it should be possible to obtain nanosecond duration pulses with power levels sufficient for meaningful laser fusion target coupling experiments.

11261 (SAND—76-5175) **High energy HF pulsed lasers.** Patterson, E.L.; Gerber, R.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 7p. (CONF-760306—1). Dep. NTIS $3.50.

From SPIE;SPSE technical symposium; Reston, Virginia, United States of America *USA* (22 Mar 1976).

Recent experiments show that pulsed HF lasers are capable of producing high energy with good efficiency. Preliminary experiments show that the laser radiation from the high-gain medium can be controlled with a low-power probe laser beam or with low-level feedback. These results indicate that the HF laser may have potential for second-generation laser fusion experiments.

11262 (SAND—76-5185) **High power atomic iodine photodissociation lasers.** Palmer, R.E.; Padrick, T.D.; Jones, E.D. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 9p. (CONF-760306—2). Dep. NTIS $3.50.

From SPIE;SPSE technical symposium; Reston, Virginia, United States of America *USA* (22 Mar 1976).

The atomic iodine photodissociation laser has developed into a system capable of producing nanosecond or shorter pulses of near infrared radiation with energies well in excess of a hundred J. Discussed are the operating characteristics, advantages, and potential problem areas associated with this laser.

11263 (UCRL—77523) **High average power, rare-gas halogen-pumped iodine laser for fusion applications.** Krupke, W.F.; George, E.V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Feb 1976. Contract W-7405-Eng-48. 27p. (CONF-760306—3). Dep. NTIS $4.00.

From SPIE;SPSE technical symposium; Reston, Virginia, United States of America *USA* (22 Mar 1976).

Pumping atomic iodine photodissociation lasers using radiation from rare-gas halogen exciplexes was described. Two basic pumping methods (incoherent and coherent) were outlined in form and some rough estimates of the relevant parameter ranges of important variables were given. The specific configurations described are two of many possible configurations and many alternatives exist.

11264 **Fission fragment excited laser system.** McArthur, D.A.; Tollefsrud, P.B. (to Energy Research and Development Administration, Washington, DC). US Patent Application 512,810. Filed date 4 Oct 1974. 14p.

The patent application concerns a laser system and method for exciting lasing action in a molecular gas lasing medium. It involves cooling the lasing medium to a temperature below about 150°K and injecting fission fragments through the lasing medium so as to preferentially excite low lying vibrational levels of the medium and to cause population inversions therein. The cooled gas lasing medium should have a mass areal density of about .005/mu/s cm^3, relaxation times of greater than 50 /mu/s, and a broad range of excitable vibrational levels which are excitable by molecular collisions. CO gas may be used. (NTIS)

11265 (UCRL-Trans—10751) **Pulsated molecular nitrogen laser emitting ultraviolet.** Girardeau-Montaut, J.P.; Roumy, M.; Hamelin, J.; Avan, L. Translated from *C. R. Hebd. Seances Acad. Sci., Ser. B;* **273**: 725-728(18 Oct 1971). 8p. Dep. NTIS $3.50.

A laser effect was obtained in molecular nitrogen by electronic pumping. The emission wave length is 3371 A and corresponds to the transition $C^3\Pi$/sub u/ yields $B^3\Pi$/sub g/ of the second positive band. The power emitted is in the vicinity of 10 kW and the light impulse has a duration of about 5 ns. (auth)

11266 (UCRL-Trans—10749) **Preparation of a laser amplifier reaching a power of 50 MW at 3371 A in molecular nitrogen.** Girardeau-Montaut, J.P.; Roumy, M.; Hamelin, J.; Avan, L. Translated from *C. R. Hebd. Seances Acad. Sci., Ser. B;* **274**: 607-610(28 Feb 1972). 7p. Dep. NTIS $3.50.

A new series of experiments on transverse electronic pumping of molecular nitrogen permitted the obtaining of an emission power close to 50 MW at 3371 A. From the results obtained with the two laser cells, of 1 m and 0.5 m in length, the gain in amplification was evaluated at 20dB. The duration of the emission is of the order of 2 ns. (auth)

11267 (UCRL-Trans—10750) **Calculation of the total power emitted at 3,371 A by a pulsed N_2 laser with transverse excitation.** Gerardeau-Montaut, J.P.; Girardeau-Montaut, C. Translated from *C. R. Hebd. Seances Acad. Sci., Ser. B;* **274**: 740-743(13 Mar 1972). 7p. Dep. NTIS $3.50.

The calculation of the total power emitted at 3371 A by a pulsed molecular nitrogen laser was made. The main steps of the process are given and numerous points of the method proposed first by Jerry then by Ali, Kolb and Anderson were adapted to this particular case. The result was compared to the signal observed by means of a photodiode under identical experimental conditions. (auth)

11268 DEFORMATION OF CERAMIC MATERIALS. PROCEEDINGS OF A SYMPOSIUM HELD IN UNIVERSITY PARK, PENNSYLVANIA, JULY 17, 18, AND 19, 1974. Bradt, R.C.; Tressler, R.E. (eds.). New York; Plenum Press (1975). 586p. (CONF-740724—). $45.00.

From Symposium on plastic deformation of ceramics; University Park, Pennsylvania, USA (17 Jul 1974).

Thirty-one papers were presented at the conference. A separate abstract was prepared for 7 papers for NSA. In addition, 2 papers were abstracted for ERA. Five papers have previously appeared in NSA. For abstracts of these see 30: 24483, 30: 27341, 30: 06461, 31: 21945, and 32: 17684. The remaining papers were not in scope for either journal. (RCK)

11269 Rotational temperature in a high-pressure pulsed CO_2 laser. Leland, W.T.; Kircher, M.J.; Nutter, M.J.; Schappert, G.T. (Los Alamos Scientific Lab., NM). *J. Appl. Phys.*; **46**: No. 5, 2174-2176(May 1975).

Small-signal gain at line center for a group of lines has been utilized to deduce the time dependence of rotational temperature in pulsed high-pressure CO_2 laser systems. Attempts to extract additional information on excited-state population densities are compromised by uncertainties in the vibration-rotation interaction. Anomalies in the small-signal gain for the P20, P28, and R14 lines of the 10.4-μ band are observed. (auth)

11270 Metal atom oxidation laser. Jensen, R.J.; Rice, W.W.; Beattie, W.H. (to U.S. Energy Research and Development Administration). US Patent 3,916,338. 28 Oct 1975. Filed date 13 May 1974. 8p.

PAT-APPL-469,737.

A chemical laser which operates by formation of metal or carbon atoms and reaction of such atoms with a gaseous oxidizer in an optical resonant cavity is described. The lasing species are diatomic or polyatomic in nature and are readily produced by exchange or other abstraction reactions between the metal or carbon atoms and the oxidizer. The lasing molecules may be metal or carbon monohalides or monoxides.

11271 Spectral enhancement of near uv xenon flashlamps. Gusinow, M.A. (Sandia Labs., Albuquerque, NM). *Appl. Opt.*; **14**: No. 11, 2645-2649(Nov 1975).

The addition of certain elements to xenon flashlamps can result in a factor of 2 to 3 enhancement of the emitted energy in the 2500 to 3000 A spectral range. The degree of enhancement is dependent on the dopant and discharge current. (auth)

11272 Spectral efficiency of pulsed high-current flashlamps. Gusinow, M.A. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.*; **46**: No. 11, 4847-4851(Nov 1975).

The spectral efficiency of flashlamps is considered as a function of xenon gas pressure, discharge current, and flashlamp bore. A detailed discussion is given concerning the optimum choice of flashlamp bore. (auth)

11273 High energy chemical laser system. Gregg, D.W.; Pearson, R.K. (to U.S. Energy Research and Development Administration). US Patent 3,928,821. 23 Dec 1975. Filed date 23 Jan 1975. 8p.

PAT-APPL-543,611.

A high energy chemical laser system is described wherein explosive gaseous mixtures of a reducing agent providing hydrogen isotopes and interhalogen compounds are uniformly ignited by means of an electrical discharge, flash-photolysis or an electron beam. The resulting chemical explosion pumps a lasing chemical species, hydrogen fluoride or deuterium fluoride which is formed in the chemical reaction. The generated lasing pulse has light frequencies in the 3-micron range. Suitable interhalogen compounds include bromine trifluoride (BrF_3), bromine pentafluoride (BrF_5), chlorine monofluoride (ClF), chlorine trifluoride (ClF_3), chlorine pentafluoride (ClF_5), iodine pentafluoride (IF_5), and iodine heptafluoride (IF_7); and suitable reducing agents include hydrogen (H_2), hydrocarbons such as methane (CH_4), deuterium (D_2), and diborane (B_2H_6), as well as combinations of the gaseous compound and/or molecular mixtures of the reducing agent.

11274 Shape and stability dependence of passively mode-locked pulses on absorber relaxation time. Hagelstein, P.L.; Ausschnitt, C.P. (Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *J. Appl. Phys.*; **47**: No. 1, 224-228(Jan 1976).

The dependence of the saturable absorber mode-locked pulse shape upon the relaxation time of the absorber is determined when the laser gain is assumed constant. The pulses are found to be asymmetric with a slowly rising edge and a more rapidly decaying edge. The mode-locked pulse width is a weak function of absorber relaxation time T/subA/, becoming broader with increasing T/subA/. Furthermore, the pulses are found to experience a delay in traversing the absorber which lengthens the cavity transit time. The growth of perturbations introduced into the steady state is shown to be bounded, indicating that stable mode-locked operation is possible even in cases where T/subA/ is comparable to or greater than the width of the steady-state pulse. (AIP)

11275 Electron-beam-controlled N_2 infrared laser. Newman, L.A.; DeTemple, T.A. (Electro-Physics Laboratory, Department of Electrical Engineering, University of Illinois, Urbana, Illinois 61801). *J. Appl. Phys.*; **47**: No. 1, 376-377(Jan 1976).

Laser action in N_2 on the first positive system ($B^3Pi/subg/yieldsA^3E^+/subu/$) has been obtained in an electron-beam-controlled discharge. Pressures of up 200 Torr (limited by the sustainer voltage available) were used resulting in a maximum output of 30-kW 2-mJ pulses at an efficiency of 0.01%. The addition of a small amount (~1 Torr) of SF_6 resulted in a doubling of the output power and energy. (AIP)

11276 Inner-shell photoionization-pumped x-ray lasers. Sulfur. Axelrod, T.S. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Rev., A;* **13**: No. 1, 376-382(Jan 1976).

The potential for use of inner-shell vacancies produced by photoionization for creation of an x-ray laser is discussed. A detailed numerical model of the physical processes involved is described and applied to sulfur, one of the most favorable materials for production of x-ray lasing at energies substantially greater than 1 keV. At solid density an x-ray pumping power of 1.7×10^{16} W/cm^2 is required with a rise time of less than 5 fsec, while at very low densities the rise-time requirement relaxes to about 50 fsec. The difficulties of meeting these requirements with current technology are discussed briefly. (AIP)

11277 Constant pulse energy power supply for a high repetition rate laser system. Lo, C.C.; Fan, B. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Rev. Sci. Instrum.*; **47**: No. 1, 63-65(Jan 1976).

A pulsed power supply system with constant pulse energy has been developed to drive flashlamps in a 0.5—5 pulses per second Nd : glass laser. By using a stable, absolute reference voltage source to set the trigger level, the energy discharged through the flashlamps is kept constant despite pulsing frequency change, power line fluctuation, and minimum dc power supply regulation. The concept can be expanded or adapted to operate other similar systems. (AIP)

11278 cw CO-CS_2, CO-C_2H_2, and CO-N_2O energy-transfer lasers. Stregack, J.A.; Wexler, B.L.; Hart, G.A. (Laser Physics Branch, Naval Research Laboratory, Washington, D.C. 20375). *Appl. Phys. Lett.*; **28**: No. 3, 137-139(1 Feb 1976).

cw laser emission has been observed from CS_2 (11.5 μ), C_2H_2 (8 μ), and N_2O (10.6 μ) transitions pumped by energy transfer from vibrationally excited CO in an electric discharge gasdynamic laser device. Proposed energy-transfer pathways for these three lasers are described. Supersonic expansion cooling plays a critical role in depopulating the lower laser levels in the CO-CS_2 and CO-C_2H_2 systems. Maximum output powers measured for each of these systems are presented. The dependence of output power on the flow rate of the injected laser species is discussed. (AIP)

11279 Laser performance of large Nd-pentaphosphate crystals. Gualtieri, J.G.; Aucoin, T.R. (Combat Surveillance and Target Acquisition Laboratory, United States Army Electronics Command, Fort Monmouth, New Jersey 07703). *Appl. Phys. Lett.*; **28**: No. 4, 189-192(15 Feb 1976).

Laser performance of twinned 90% Nd—10% Y-pentaphosphate (0.9 Nd—0.1 YP_5O_{14}) crystals with dimensions typically 4.5x3 mm in diamond-shaped cross-section by 2 mm thick is reported. Power conversion efficiencies of ≅24% and peak power outputs of approximately 240 mW were obtained under optical excitation with a repetitively pulsed argon laser. Samples of 0.75 Nd—0.25 InP_5O_{14}, 0.1 Nd—0.9 YP_5O_{14}, 0.1 Nd—0.9 CeP_5O_{14}, and 0.1 Nd—0.9 GdP_5O_{14} were also lased. (AIP)

11280 Optical gain in a neutron-induced ^{3}He-Ne-O_2 plasma. DeYoung, R.J.; Wells, W.E.; Miley, G.H. (Nuclear Engineering Program, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Appl. Phys. Lett.*; **28**: No. 4, 194-197(15 Feb 1976).

A single pass gain of ~0.9% p/m (at 8446 A in atomic oxygen) has been measured for a ^{3}He-Ne-O_2 plasma generated by the volumetric ^{3}He(n,p)^{3}H reaction induced by neutrons from a pulsed nuclear reactor. The plasma was contained in an optical cavity containing a chopping fan that permitted a measurement of the ratio of output 8446 A from the normal cavity to that with the back mirror blocked. This ratio, called the unblocked-blocked ratio, was used to study the gain dependence on total pressure and

concentration. The maximum gain observed was for a concentration of 0.048% O_2 and 1.5% Ne, at a total pressure of 600 Torr. The peak gain remained fairly constant with neutron fluxes from 10^{13} to 2.5×10^{15} n/cm² s. Results of other concentration studies are also discussed. The laser medium is pumped by thermal neutrons from the Illinois TRIGA reactor that impinge on a 80-cm by 0.8-cm-ID glass tube containing from 50 to 800 Torr ^3He-Ne-O_2. (AIP)

11281 A potential high-efficiency Cl_2 ultraviolet laser. Chen, C.H.; Payne, M.G. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Appl. Phys. Lett.*; **28**: No. 4, 219-221(15 Feb 1976).

An emission band extending from 2200 to 3000 A has been observed following proton beam excitation of Ar-Cl_2 mixtures which is much more intense than the emission from Ar-N_2. The emission band was assigned to a bound-free transition in the chlorine molecule. The energy precursor of excited Cl_2 is the excimer Ar_2^* which emits a 1300-A continuum. Ion-ion recombination can also contribute to this excited chlorine molecule. The emission continuum near the 1750 A associated with ArCl* was also investigated. (AIP)

11282 High-power visible laser action in neutral atomic fluorine. Bigio, I.J.; Begley, R.F. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Appl. Phys. Lett.*; **28**: No. 5, 263-264(1 Mar 1976).

Atomic fluorine is produced by dissociation of NF_3 in a fast-pulsed electrical discharge in helium. High-power laser action is observed, with 70 kW on five lines near 7100 A, all of which are assigned to electronic transitions in neutral atomic fluorine. Two of the laser lines are reported here for the first time. Some scalability appears possible for this laser, which already has proven to be an excellent pump source for infrared laser dyes. (AIP)

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 10673, 10681, 10960, 11226, 11391

11283 (ANL-CT—76-22) **Mathematical and programming details of the TEACH T and L recirculating flow code.** Salimonu, D.O. (Argonne National Lab., Ill. (USA)). Oct 1975. 45p. AT.

A summary of the essential mathematical details of both TEACH programs is presented. The variables used in the programs and the functions of each of the program subroutines are explained. (auth)

11284 (K—1864) **Two-phase flow pressure drop and heat transfer characteristics of refrigerants in vertical tubes.** Jallouk, P.A. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 579p. Dep. NTIS $14.75.

Research was undertaken to study the two-phase flow characteristics of refrigerants in vertical tubes. An experimental study was made of the flow regime, pressure drop, heat transfer coefficient, and critical heat flux of R-114 boiling in a 0.785-in.-ID, 10-ft-long vertical tube. The boiling temperature was varied in the range of 100 to 250°F for all tests except the heat transfer coefficient runs where the range 100 to 200°F was studied. The mass flux range was 0.12 less than or equal to G less than or equal to 3.5×10^6 lbm/hr-ft². Analytic and experimental techniques were used to investigate the heat transfer and pressure drop characteristics. An improvement in the prediction of the system behavior was obtained and the discrepancies between the behavior of boiling refrigerants and other working fluids have been explained. New equations were developed or existing ones verified so that design engineers requiring information on the two-phase flow characteristics of refrigerants in vertical tubes at operating conditions not too different from those studied here may use the equations presented here. The limitations of each equation are also presented. Recommendations for further investigation are given. (auth)

11285 (SAND—75-0571) **Finite element analysis of problems in convective heat transfer.** Gartling, D.K. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 34p. Dep. NTIS $5.00.

The finite element method has been applied to a general class of problems in convective heat transfer. The method was incorporated in a user-oriented computer program. Several typical problems were solved to demonstrate the accuracy and generality of the approach. (auth)

11286 (UCRL—50028-75-2, pp 16-21) **Code development group.** 1975.

In H-Division quarterly report, April—June 1975.

The mission of H-Division's Code Development Group is the development of time-dependent, compressible-fluid-mechanics programs. They are concerned with coupled Eulerian-Lagrangian methods (CEL and CHAMP) as well as with the generalized Eulerian method TEULER. The motivation in each case is related to developing codes (based on either known or new methods) that are aimed at solving several general classes of fluid-flow problems. Progress is reported on CELMOCH- a link from CEL to MOCHA; TEULER- a computational fluid dynamics development; CHAMP- a multifluid program; BLIP- a ballistically interactive particles code; and LEEK- a code to provide boundary conditions to HEMP in the absence of a physical boundary. (TFD)

11287 Flow of interpenetrating material phases. Harlow, F.H.; Amsden, A.A. (Los Alamos Scientific Lab., NM). *J. Comput. Phys.*; **18**: No. 4, 440-464(Aug 1975).

A previously described numerical technique for the solution of multiphase flow dynamics problems is here both simplified and extended. The simplification cuts down slightly on the momentum coupling among fields, allowing for considerable reduction in complexity of the formulation. The extensions include the capability for compressibility in each material phase, the addition of more interpenetrating fields, and the allowance for motion of a liquid or vapor through a close-packed field of particles. The technique is illustrated by computer-generated plots from a time-varying three-field calculation in a cylindrically symmetric configuration. (auth)

11288 Coil spring venting arrangement. McCugh, R.M. (to U.S. Energy Research and Development Administration). US Patent 3,913,599. 21 Oct 1975. Filed date 30 Sep 1974. 8p.

PAT-APPL-510,839.

A simple venting device for trapped gas pockets in hydraulic systems is inserted through a small access passages, operated remotely, and removed completely. The device comprises a small diameter, closely wound coil spring which is pushed through a guide temporarily inserted in the access passage. The guide has a central passageway which directs the coil spring radially upward into the pocket, so that, with the guide properly positioned for depth and properly oriented, the coil spring can be pushed up into the top of the pocket to vent it. By positioning a seal around the free end of the guide, the spring and guide are removed and the passage is sealed.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 10234

11289 (HEDL-TME—75-133) **Feasibility study on infrared electro-thermal NDE of stainless steel.** Green, D.R.; Hassberger, J.A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-2170. 20p. Dep. NTIS $4.50.

Electro-thermal examination, a branch of thermal testing (TT), is a promising method being developed for NDE of stainless steel welds. This report describes the first phase of development; i.e., preliminary demonstration and laboratory evaluation of the method's sensitivity to notches in Type 304 stainless steel plate specimens. It also includes a description of the basic principles, together with a description of the hardware and experimental results showing that electrical discharge machined notches down to 0.16 cm (0.06 in.) long x 0.08 cm (0.03 in.) deep were detected. A qualitative technique for interpreting the test results to determine whether defects are at the surface or deeper within the material is demonstrated. (auth)

11290 (HEDL-TME—75-134) **Development of ultrasonic methods for examining stainless steel welds. Interim progress report.** Peterson, R.O.; Spanner, J.C.; Mech, S.J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-2170. 31p. Dep. NTIS $5.00.

Spurious ultrasonic (UT) signals obtained during the examination of austenitic stainless steel welds in LMFBR components have emphasized the need to develop more effective UT methods to supplement the examination processes presently employed during fabrication, and for use during subsequent in-service inspection of LMFBR plants. This interim report documents the first year's effort on a program that was designed to investigate this problem and develop viable solutions. Sixty-eight weld samples were acquired, cataloged, and subjected to a series of ultrasonic, radiographic, and metallographic examination procedures. It was determined that although spurious UT noise signals could usually be associated with major dendritic grain growth patterns, the existence and magnitude of some of the observed noise signals could not be explained simply on the basis of dendritic microstructure. The results obtained during application of a series of ultrasonic and

radiographic characterization procedures are included, in addition to photomicrographs and photomicrographic montages taken in the vicinity of numerous sites which produced ultrasonic noise signals of various amplitudes. A concurrent investigation was conducted to evaluate the performance of conventional ultrasonic examination procedures. These results are compared with the laboratory investigation results, and a brief outline of future work planned under this program is presented. (auth)

11291 (JAB—99-119) **Vibration tests of a 4-story reinforced concrete test structure.** Chen, C.K.; Czarnecki, R.M.; Scholl, R.E. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). Jan 1976. 108p. Dep. NTIS $6.50.

The results of a series of vibration tests conducted in 1974 to determine the dynamic response characteristics of a 4-story concrete test structure located at the Nevada Test Site are presented. The testing of this structure can be generally categorized as follows: nondestructive tests consisting of frequency sweep tests and frequency dwell tests, exciting four translational modes of vibration in the north-south (longitudinal) direction and three modes in the east-west (transverse) direction at low and intermediate force levels; a destructive test consisting of a frequency dwell test, exciting the lowest north-south translational mode at intermediate and high force levels, during which the structure exhibited inelastic response and suffered major structural damage; and a series of post-destructive tests using force levels similar to the nondestructive tests, conducted to investigate the response of the structure after it had experienced structural damage. The damping values of all modes over the range of nondestructive testing varied from 1.3 percent to 2.3 percent of critical. The damping in the second mode appeared to be higher than in the other modes at all amplitudes within the measurements, suggesting a complex but as yet undefined relationship between frequency, mode shape, amplitude, and damping in such structures. Mode shape of vibration or each mode measured in one direction of motion was found to be nearly constant regardless of levels of excitation. No observable damage was found during this test series. (auth)

11292 **Method for testing wire rope.** Lear, G.W.; Lockwood, H.E.; Pointer, F.E. (to U.S. Energy Research and Development Administration). US Patent 3,916,686. 4 Nov 1975. Filed date 24 Oct 1974. 6p.

PAT-APPL-517,662.

A system for determining the quality of wire rope or cable was designed. The thermal increase in a rope when it is performing work is utilized to determine its quality, a poorer quality rope displaying a larger temperature rise than a higher quality rope.

11293 **High temperature aqueous stress corrosion testing device.** Bornstein, A.N.; Indig, M.E. (to U.S. Energy Research and Development Administration). US Patent 3,922,903. 2 Dec 1975. Filed date 27 Sep 1974. 4p.

PAT-APPL-509,990.

A description is given of a device for stressing tensile samples contained within a high temperature, high pressure aqueous environment, thereby permitting determination of stress corrosion susceptibility of materials in a simple way. The stressing device couples an external piston to an internal tensile sample via a pull rod, with stresses being applied to the sample by pressurizing the piston. The device contains a fitting/seal arrangement including Teflon and weld seals which allow sealing of the internal system pressure and the external piston pressure. The fitting/seal arrangement allows free movement of the pull rod and the piston.

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 11223

11294 (ORNL/TM—5309) **Laboratory services series: an electrical outlet and corded equipment inspection program.** Davis, E.A. (Oak Ridge National Lab., Tenn. (USA)). Apr 1976. Contract W-7405-eng-26. 15p. Dep. NTIS $3.50.

A research and development laboratory has thousands of electrical outlets providing power to laboratories, offices, shops, and service areas. These outlets provide power for a wide variety of portable equipment and tools that are equipped with cord and plug. Electric safety requires a periodic check of outlet grounding capability and continuing inspection and repair of corded equipment. Personnel, equipment, reports, procedures, and schedule requirements are reported.

11295 **Coaxial cable connectors.** Stokes, D.B. (to U.S. Energy Research and Development Administration). US Patent 3,910,673. 7 Oct 1975. Filed date 18 Sep 1973. 6p.

PAT-APPL-398,363.

A coaxial cable connector suitable for a group of cables having the same nominal size and impedance characteristics is described. Clamping force is applied on the outer conductor of the cable in the radially inward direction upon fastening the backshell to the body of the connector. A subassembly captivated within the backshell forces a deformable material into sealing contact with the outer surface of the cable upon fastening the backshell to the body.

11296 **Solder leveling process.** Allen, T.A.; Sylvester, R.T. (to U.S. Energy Research and Development Administration). US Patent 3,924,794. 9 Dec 1975. Filed date 2 Dec 1974. 6p.

PAT-APPL-528,975.

Removal of excess or undesirable solder from printed circuit boards that may contain through-holes, conductors, connectors, etc. is accomplished by covering such boards with liquid flux, contacting with liquid solder, removing from the solder, and subsequently passing intermediate offset, hot gas jets which flow hot gas under pressure onto the boards and sweep off undesired solder, clear the holes, and leave an optimum thickness solder layer.

SOLID WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 10395, 10396, 10397, 10400, 10941

PARTICLE ACCELERATORS

11297 (CONF-741040—P2) **Proceedings of the third conference on application of small accelerators, Denton, Texas, October 21—23, 1974. Volume II. Industrial applications of small accelerator.** Duggan, J.L.; Morgan, I.L. (eds.). (North Texas State Univ., Denton (USA)). 1974. 392p. Dep. NTIS $10.60.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

This conference is the third symposium on the Application of Small Accelerators. The two previous conferences were concerned mainly with research and teaching applications of accelerators. This 1974 conference was composed of two symposia which ran in parallel. The first symposium was mainly directed towards research and teaching applications of accelerators. The papers from this symposium were published as Volume I, "The Use of Small Accelerators in Research and Teaching." The second symposium covered the "Industrial Applicationfs of Small Accelerators" and Volume II of the 1974 proceedings has that title. Twenty-seven papers were abstracted for ERDA Energy Research Abstracts (ERA), and 23 for Nuclear Science Abstracts (NSA). (SFL)

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 11326

11298 (BNL—50445, pp 72-77) **Bevalac, a high-energy heavy-ion facility: status and outlook.** Grunder, H.A. (Univ. of California, Berkeley). 1974.

From BeV;nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In Report of the workshop on GeV/nucleon collisions of heavy ions: how and why.

The high-energy heavy-ion facility, which has commonly been referred to as the Bevalac, is a synchrotron with B rho of 9000 [kG-in or 2.3 x 10^2 kG-m] having special injectors. The synchrotron has three injectors. The 50 MeV proton injector, originally from BNL, is a tool left over from the high-energy high-intensity days of this productive synchrotron. The 20 MeV linac is a proton linac, designed so conservatively that it was possible to accelerate modest but useful beams of ^{12}C, ^{14}N, and ^{16}O as well as deuterons and alpha particles in the 2 β lambda mode. This was accomplished in 1971. After our first trials, a suggestion made earlier by A. Ghiorso to inject from the SuperHILAC into the synchrotron was actively pursued. Reasons as to why the SuperHILAC is being used as injector to the Bevatron are given. (WHK)

11299 (BNL—50445, pp 79-85) **Heavy-ion, A >200, acceleration in the AGS.** Prelec, K.; van Steenbergen, A. 1974.

From BeV;nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In Report of the workshop on GeV/nucleon collisions of heavy ions: how and why.

Acceleration in the AGS of approximately 10^9 heavy ions per sec, with mass number A greater than 200, to kinetic energies of 1 less than T/sub N/ less than 10 GeV/nucleon is feasible without modification of basic AGS subsystems by using a (surplus) fast cycling synchrotron as a booster ring. This booster is required in order to obtain the fully stripped ion state, since partially stripped ion acceleration in a slow rise-time accelerator is impractical because of extreme vacuum pressure requirements. The fast cycling feature of the booster is essential in reducing transmission losses associated with electron capture or loss during acceleration and is beneficial in increasing the exit beam intensity.

11300 (BNL—50445, pp 86-89) **PPA as a relativistic heavy-ion accelerator.** White, M.G. (Princeton Univ., NJ). 1974.

From BeV;nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In Report of the workshop on GeV/nucleon collisions of heavy ions: how and why.

The feasibility of converting the Princeton Particle Accelerator (PPA) to a heavy ion facility with a booster accelerator is discussed. Options include a tandem Van de Graaff, a storage ring which would allow double acceleration in the PPA, and an improved ion source. (PMA)

11301 (LA-UR—75-2383) **Status of the Clinton P. Anderson Meson Physics Facility (LAMPF).** Jain, M.; Rosen, L. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 13p. (CONF-751223—1). Dep. NTIS $3.50.

From 7. international conference on few body problems in nuclear and particle physics; New Delhi, India (29 Dec 1975).

A brief history and a description of the LAMPF Linac is given, followed by a discussion of the experimental areas, some selected experimental results, and some practical applications. Differential cross section data for n-p charge exchange scattering near 640 MeV are compared with data taken on other machines, and data on pion scattering are presented. The application of negative pions to the treatment of cancer is discussed. (PMA)

11302 (LBL—4602) **Very high energy heavy-ion accelerators.** Grunder, H.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-ENG-48. 6p. (CONF-751048—7). Dep. NTIS $3.50.

From International conference on heavy ion sources; Gatlinburg, Tennessee, USA (27 Oct 1975).

A review is given of various programs for building heavy ion accelerators. Topics discussed are (1) options of reaching very high energies with heavy ions; (2) present performance of the superHILAC and the Bevalac; (3) heavy ion sources; (4) applications of heavy ion accelerators outside of basic research; and (5) reliability and operating costs of heavy ion sources. (PMA)

11303 (ORO—4856-48) **Some highlights of the University of Maryland Cyclotron.** Pugh, H.G. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jul 1975. 13p. Dep. NTIS $3.50.

A review is given of the beam energies, the cyclotron layout, the personnel, and use of the Maryland Cyclotron. The discussion of some of the experiments includes: (1) pion production; (2) elastic proton scattering at 100 MeV; (3) quasi-free processes; (4) gamma rays following proton bombardment; (5) highly excited nuclear states; and (6) rearrangement energy. (PMA)

11304 (TID—26942) **Monthly report of the Fermi National Accelerator Laboratory.** Sanford, J.R. (ed.). (Fermi National Accelerator Lab., Batavia, Ill. (USA)). Nov 1975. 24p. Dep. NTIS $3.50.

The first neutron beam was obtained in the Cancer Therapy Facility at Fermilab, and measurements of beam characteristics, mainly the determination of dose distributions, were begun. Beam requirements for medical research, beam transport, facility funding, and facility status and long-term schedule are discussed. The general use of the Fermilab Accelerator during the month of October 1975 is summarized. (PMA)

11305 (TID—26948) **Methods for transporting kaons to bubble chambers at Fermilab.** Albright, J.R. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). 19 Aug 1975. 19p. Dep. NTIS $3.50.

A review is given of various beam transport methods that are proposed for beams of charged and of neutral kaons to be used in bubble chamber experiments. So far, there are no plans to produce separated beams of kaons at Fermilab energies; instead emphasis was placed on the concept of enriched beams. For charged particles, there will be some contamination in the beam, but the contamination will be identified by counters and wire chambers on a track-by-track basis. The enrichment refers to the use of various strategems to improve the ratio of wanted to unwanted particles so as to avoid undue waste of film and running time. (auth)

11306 **SLAC is healthy.** *CERN Cour.*; **16**: No. 1, 10-11(Jan 1976).

A brief report of the operational status of SLAC is given. Among the topics discussed are polarized electron beams, the large aperture superconducting solenoid spectrometer (LASS), the electron-positron storage ring (SPEAR), the proposed 15 GeV electron-positron storage ring (PEP), and various experimental facilities. (PMA)

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

11307 (BNL—50474) **Computer program simulating the interaction of a proton beam with a resonant cavity and an rf cavity.** Messerschmid, E.W. (Brookhaven National Lab., Upton, N.Y. (USA)). 29 Aug 1975. Contract E(30-1)-16. 46p. Dep. NTIS $5.00.

An up-to-date description is given of a computer program simulating the interaction of a proton beam circulating in an AG accelerator or storage ring and interacting with a resonant cavity and an rf accelerating gap. A presentation of the theory is given upon which the simulation program is based. It is followed by a formal description of the program structure and some details of the incorporated procedures. Scaling considerations of the computer model which have to be taken into account in the choice of parameters and in the interpretation of results are discussed. (auth)

AUXILIARIES AND COMPONENTS

11308 (CONF-750968—6) **Carbon foils as heavy ion strippers.** Yntema, J.L. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 9p. Dep. NTIS $3.50.

From 4. annual international conference of the Nuclear Target Development Society; Argonne, Illinois, USA (29 Sep 1975).

A discussion is given of the advantages and disadvantages of thin carbon foil strippers for heavy ion beams from tandem electrostatic accelerators. Foil lifetimes were increased by radiative heating and by the evaporation of a thin layer of gold on the foil. (PMA)

11309 (SAND—75-0464) **Techniques for fabricating an infrared optical pyrometry system for pulsed electron beam diagnostics.** Ouellette, A.L (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 25p. Dep. NTIS $4.50.

A description is given of an infrared optical pyrometry system which was designed to make fast time resolved temperature measurements. The purpose of this equipment is to determine the amount of energy from an electron beam or some other type of pulsed energy deposition that is absorbed in a target. The system is capable of measuring energy deposition levels up to 4000 J/g in carbon, which corresponds to a graphite target temperature of 2200°C. Methods of fabrication, alignment, and calibration are presented. The measurement of absorbed energy in a target as a function of position and depth is discussed as a possible application, and several measurements are described which permit a comparison of results from this system with those taken by other methods.

11310 (SAND—75-5494) **X-ray simulation development.** Posey, L.D.; Tollefsrud, P.B.; Woodall, H.W.; McDaniel, D.H.; Allred, R.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 25p. (CONF-751094—1). Dep. NTIS $3.50.

From 5. symposium on nuclear survivability of propulsion and ordnance systems; Menlo Park, California, United States of America "USA" (7 Oct 1975).

Design modifications are discussed for an electron beam accelerator used as a Bremsstrahlung x-ray source. The primary goal of the program, to obtain a reliable 5 cal/gm exposure capability, can be accomplished with beam compression by an external magnetic guide field. Inital operating characteristics and performance improvements are presented. (PMA)

11311 **Ring magnet firing angle control.** Knott, M.J.; Lewis, L.G.; Rabe, H.H. (to U.S. Energy Research and Development Administration). US Patent 3,914,681. 21 Oct 1975. Filed date 6 Nov 1974. 10p.

PAT-APPL-521,418.

A device is provided for controlling the firing angles of thyratrons (rectifiers) in a ring magnet power supply. A phase lock loop develops a smooth ac signal of frequency equal to and in phase with the frequency of the voltage wave developed by the main generator of the power supply. A counter that counts from zero to a particular number each cycle of the main generator voltage wave is synchronized with the smooth AC signal of the phase lock loop. Gates compare the number in the counter with predetermined desired firing angles for each thyratron and with coincidence the proper thyratron is fired at the predetermined firing angle.

11312 Relativistic electron beam generator. Mooney, L.J.; Hyatt, H.M. (to U.S. Energy Research and Development Administration). US Patent 3,919,580. 11 Nov 1975. Filed date 11 Sep 1974. 6p.

PAT-APPL-504,933.

A relativistic electron beam generator for laser media excitation is described. The device employs a diode type relativistic electron beam source having a cathode shape which provides a rectangular output beam with uniform current density.

11313 1000 GeV next stop. *CERN Cour.*; **16**: No. 1, 12-13(Jan 1976).

A brief review is given of the status of the Energy Doubler/Saver, a project at Fermilab to double the peak energy by adding a ring of superconducting magnets. The experimental motivation for the project, the power consumption of the magnets, and the magnet cooling system are discussed. (PMA)

ION SOURCES

REFER ALSO TO CITATION(S) 11683

11314 (LBL—3399(Suppl.), pp I.3.1-I.3.6) **Oscillations in a duoplasmatron ion source.** Kobayashi, M.; Takagi, A. (National Lab. for High Energy Physics, Ibaraki-ken, Japan). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

Coherent oscillations with the frequencies of 1 to 3 MHz were observed in a high current pulsed duoplasmatron for hydrogen gas. The dependences of the frequencies and amplitudes on the source parameters are presented The oscillation frequency increases as B increases. It is inversely proportional to the I. E.-to-anode distance, and has an approximate dependence of $1\sqrt{M}$ for different gases. It seems reasonable to explain the oscillation in terms of ion-acoustic wave in the anode plasma. Operation at high arc current with weak magnetic field is favorable for obtaining oscillation-free beams. (auth)

11315 (LBL—3399(Suppl.), pp II.5.1-II.5.6) **Duoplasmatron with a nozzle type plasma expension cup.** Kobayashi, M.; Nishikawa, T.; Takagi, A. (National Lab. for High Energy Physics, Ibaraki-ken, Japan). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

Various tests are described which were carried out in order to clarify the cause of the aberration existng in the beams extracted from a nozzle type plasma expansion cup. The tests involve the extraction electrodes having different edge shapes, gridded extraction electrodes, high-voltage facing electrodes at the cup exit making different angles with the axis, plasma cups having different contours at the exit, plasma cups gridded at the exit, biasing the cup exit with respect to anode, plasma cups having different ratios of the exit area to axial length, etc. The results show that the inward meniscus type distortion of the plasma boundary near the rim of plasma cup will be a dominant source for the aberration. Both proper shaping of the contour of the cup exit and biasing the cup exit reduced the aberration. (auth)

11316 (LBL—3399(Suppl.), pp II.6.1-II.6.5) **Continuously displayed emittance measurements.** Billen, J.H. (Univ. of Wisconsin, Madison). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

A description is given of a device to dsplay continuously on a CRT the emittance of an ion beam. The sytem uses electrostatic deflectors and small apertures to scan the beam transverse position and momentum coordinates. Measurements here reported include: (1) emittance and brightness of many different ion beams from five different type sources; (2) a study of the emittance of an H^- beam as a function of the radial displacement of the zwischen electrode in a duoplasmatron direct extraction source; and (3) a phase space particle density profile for a H^- beam. (auth)

11317 (LBL—3399(Suppl.), pp III.3.1-III.3.6) **Ion sources for a collective ion accelerator.** Olson, C.L.; Kuswa, G.W.; Swain, D.W.; Poukey, J.W. (Sandia Labs., Albuquerque, NM). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

Collective ion acceleration schemes that utilize an intense relativistic electron beam (approximately 1.5 MeV, 30 kA, 70 ns) to create a deep, moving potential well (for accelerating and focusing an ion bunch) have been recently proposed. In these schemes, the ion source would provide a pulsed, partially-stripped, essentially stationary ion bunch. The proposed final accelerated ion bunch current would be less than 100 A and the pulse length would be less than 1 ns. Three different ion sources appropriate for these collective acceleration applications were investigated. These include e-beam extraction and acceleration of ions from: (1) a beam-ionized neutral gas; (2) a beam-vaporized and beam-ionized solid thin film target; and (3) a laser-irradiated solid target embedded in the anode foil. Method (1) has been demonstrated previously. Methods (2) and (3) appear to be feasible based on theoretical work presented here, although present experimental results (also presented here) were dominated by anode foil impurity ions. For collective acceleration applications, the necessity of using these pulsed, effectively high-current sources instead of conventional sources is noted. (auth)

11318 (LBL—3399(Suppl.), pp IV.1.1-IV.1.7) **Polarized ion sources.** Glavish, H.F. (Stanford Univ., CA). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

A brief account is given of the motivation for building polarized ion sources. This is followed by a simple description of the basic principles of the "ground state" and "Lamb shift" types of sources. The performance levels currently achieved are discussed, and detailed diagrams of actual sources are included. There is a section on the recent application of a polarized ion source to the Argonne Zero Gradient Synchotron. References are given which relate to the possibility of producing polarized particles other than protons and deuterons. Developments that might lead to increased beam currents are discussed. (auth)

11319 (LBL—3399(Suppl.), pp IV.4.1-IV.4.2) **Design and operation of the McMaster polarized ion source (II).** McKay, J.W. (McMaster Univ., Hamilton, Ont.). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

A Lamb Shift spin filter polarized ion source was constructed for the McMaster University F. N. Tandem Accelerator. Cryogenic pumping devices were used in the argon cell region to control the heavy gas loads and to ensure clean vacuum conditions. Initial testing of the source is also discussed. (auth)

11320 (LBL—3399(Suppl.), pp IV.5.1-IV.5.6) **Comparison of high-intensity multiaperture and single-aperture duoplasmatrons for a lamb-shift polarized ion source.** Trainor, T.A. (Univ. of North Carolina, Chapel Hill, NC); Clegg, T.B. 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

A high intensity duoplasmatron was constructed, and two different extraction systems were used with this ion source to produce positive ion beams for a Lamb-shift source. The multiaperture system consists of a 2 cm dia hexagonal array of 55 apertures, each 2.2 mm dia, in three aligned electrodes. Total extracted beam with this system is typically 50 mA. A 1.1 kV D^+ ion beam of 24 μA is delivered to a 1.25 cm dia suppressed Faraday cup 160 cm from the ion source. The single-aperture system consists of two 70° conical electrodes separated by a flat 3.2 mm thick electrode with a 6.3 mm dia aperture at the center. Total extracted beam with this system is typically 10 mA. A beam intensity of 11.5 μA is observed at the Faraday cup. Arc currents during these measurements are typically 20 A. Polarized beam quality with the single-aperture extraction system is far superior to that corresponding to the multiaperture system. Factors contributing to this result are discussed. (auth)

11321 (LBL—3399(Suppl.), pp IV.6.1-IV.6.2) **Lamb-shift polarized H⁻ source for the University of Manitoba cyclotron.** Oh, S.; McIlwain, A. (Univ., of Manitoba, Winnipeg). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

A Lamb-shift polarized H⁻ source is being planned for use with the University of Manitoba Cyclotron. The source will employ the diabatic field reversal method. Construction will allow the possibility of conversion to the spin filter type later. Construction of the accompanying external injection system is in progress. (auth)

11322 (LBL—3399(Suppl.), pp IV.8.1-IV.8.4) **Performnce of a ground state polarized ion source in the high voltage terminal of the Ohio State CN Van de Graaff accelerator.** Donoghue, T.R.; McEver, W.S.; Schieck, H.P.; Volkers, J.C.; Busch, C.E.; Doyle, M.A.; Dries, L.; Regner, J.L. (Ohio State Univ., Columbus). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

A polarized ion source was constructed for operation in the high voltage terminal of a pressurized Van de Graaff accelerator. A report is given on the recent developments that have contributed to the successful operation of this source within the accelerator. The source is currently used for nuclear physics experiments, with typical beam and polarization on target of 60 nA and p/sub y/ = 0.65 for protons and 30 nA and p/sub zz/ = 0.80 for deuterons. (auth)

11323 (LBL—3399(Suppl.), pp IV.9.1-IV.9.5) **Polarized beam facility in Giessen, Germany.** Arnold, W.; Clausnitzer, G. (Univ., Geissen, Ger.). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

The source of polarized particles employs the Lamb shift method, using two quenching coils with a Sona-transition region in between. Negative hydrogen currents of 600 nA were obtained from the source and injected into a small pressurized 1.2 MeV tandem-accelerator. Polarized proton currents of 300 to 400 nA were measured after a 1 mm x 1 mm aperture with a polarization of 64 percent, determined from the $^{9}Be(p,\alpha)$-asymmetry. (auth)

11324 (LBL—3399(Suppl.), pp V.1.1-V.1.17) **Principal parameters of classical multiply charged ion sources.** Winter, H. (Technische Hochschule, Vienna); Wolf, B.H. 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

A review is given of the operational principles of classical multiply charged ion sources (operating sources for intense beams of multiply charged ions using discharge plasmas; MCIS). The fractional rates of creation of multiply charged ions in MCIS plasmas cannot be deduced from the discharge parameters in a simple manner; they depend essentially on three principal parameters, the density and energy distribution of the ionizing electrons, and the confinement time of ions in the ionization space. Simple discharge models were used to find relations between principal parameters, and results of model calculations are compared to actually measured charge state density distributions of extracted ions. Details of processes which determine the energy distribution of ionizing electrons (heating effects), confinement times of ions (instabilities), and some technical aspects of classical MCIS (cathodes, surface processes, conditioning, life time) are discussed. (auth)

11325 (LBL—3399(Suppl.), pp VII.9.1-VII.9.4) **ICT high efficiency duoplasmatron ion source.** Booth, R. (Univ. of California, Livermore). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

The duoplasmatron ion source of the Livermore 400 kV ICT accelerator was modified to increase the target current from the accelerator. In routine operation, D^{+} currents on target of 18 to 22 mA are now produced rather than the 5 to 8 mA originally available. The major modification to the source was the installation of a focus electrode between the plasma expansion cup and the accel-decel extraction electrode system. With this arrangement, the source output may be varied from maximum down to zero beam level without excessive extractor loading. Beam divergence varies from 6 mrad to 30 mrad. The focusing and extraction electrodes are simple to fabricate and are radiation cooled. Beam transport efficiency of 75 percent was obtained through the 15 m long x 10 cm diameter transport system. The increase in target current was obtained without decreasing the reliability of the accelerator. (auth)

11326 (LBL—3399(Suppl.), pp VII.12.1-VII.12.5) **Performance of a moderate intensity ion source and accelerator for use in neutron radiotherapy.** DeLuca, P.M.; Tesmer, J.R.; Chenevert, G.M.; Torti, R.L.; Kelsey, C.A. (Univ. of Wisconsin, Madison). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

A neutron generator, consisting of a duoplasmatron, a "Pierce-type" accelerating structure, and a windowless gas target was constructed. The device is designed to provide a relatively inexpensive intense source of fast neutrons for cancer treatment. The neutrons (15 MeV) are produced by the $^{3}H(d,n)^{4}He$ reaction. Among the characteristics of the system discussed are ion source and gas target performance, beam emittance, and neutron production. (auth)

11327 (LBL—3399(Suppl.), pp VIII.2.1-VIII.2.12) **Negative hydrogen sources for beam currents between one milliampere and one ampere.** Sluyters, T. (Brookhaven National Lab., Upton, NY). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

A review is given of the methods employed in the production of negative hydrogen ions in the current range of 1 mA to 1A. (auth)

11328 (LBL—3399(Suppl.), pp VIII.3.1-VIII.3.3) **Development of a direct extraction ion source for an FN Van de Graaff terminal.** Roth, G.W.; Weitkamp, W.G. (Univ. of Washington, Seattle). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

A direct extraction duoplasmatron ion source was installed in the terminal of the negative injector of the University of Washington HVE three-stage model FN Van de Graaff accelerator. With this ion source, the injector produces hydrogen ion beams of higher intensity than was possible with the previous neutral negative configuration. It also produces intense heavy ion beams which can be more highly ionized by the tandem stripper foil, because the beam energy at the foil is about twice as high as was possible previously. The result is a significant increase in total accelerator beam energy for heavy ions. The installation minimizes volume, weight, and power consumption, while preserving ease of maintenance. The duoplasmatron is gas cooled, with a permanent magnet produced plasma constriction field, and a glass filament holder containing two filaments. Operating parameters are monitored using analog optical telemetry channels. The source performs satisfactorily and has been used for nuclear research. (auth)

11329 (LBL—3399(Suppl.), pp VIII.7.1-VIII.7.3) **Improvement in performance of an alcaline vapor charge exchange canal.** Dumail, M.; Denoit, M.; Le Scornet, J.C. (Institut de Physique Nucleaire, Orsay, France). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

In negative ion sources with alkali metal vapor charge exchange canals, the generated beam output decreases, often rapidly, with time. A new canal and new refrigerated baffles were designed so that the condensed alkali metal is located off the axis, and extends beyond the internal edge of the baffles. Under these conditions, the performance of the negative source remains constant as long as there is some metal in the reservoir. (auth)

11330 (LBL—3399(Suppl.), pp VIII.9.1-VIII.9.4) **Sputter PIG Source (SPIGS) for negative ions.** Smith, H.V. Jr.; Richards, H.T. (Univ. of Wisconsin, Madison). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

A description is given of a radial extraction sputter PIG Source (SPIGS) which uses cathode sputtering by an argon plus cesium vapor discharge to produce a wide variety of low emittance negative ion beams, including metallic ions. With appropriate

cathodes the following intensities were possible: C^-, 3 μA; V^-, 0.1 μA; Ni^-, 4 μA; Cu^-, 8 μA; and Nb^-, 0.2 μA. The source can also be used for the gaseous elements by using low sputtering cathodes and the appropriate parent gas for the discharge. The operating lifetime of the present version of SPIGS is approximately 100 hours. SPIGS is compared with other sources of negative metallic ions, and a possible explanation for the reported higher emittance of another source is offered. Work continues on improving beam intensities, source operating lifetime, and extending the negative ion species available. (auth)

11331 (LBL—4075) **Emittance measurements of high charge state argon beams from a pig source.** Bex, L.; Clark, D.J.; Ellsworth, C.E.; Estrella, R.M.; Gough, R.A.; Holley, W.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-Eng-48. 5p. (CONF-751048—6). Dep. NTIS $3.50.

From International conference on heavy ion sources; Gatlinburg, Tennessee, USA (27 Oct 1975).

The emittances of beams of Ar^{4+} to Ar^{8+} were measured in the axial and radial planes. The extraction voltage was 10 kV and the magnetic field was varied from about 0.5 to 0.6 Tesla. The anode slit was varied in distance from the arc, which was run both dc and pulsed. The emittance was nearly independent of charge state, but increased with total beam current. A small bowing of the arc column, which made evaluation of mirror field effects difficult, was discovered. (auth)

11332 (LBL—4348) **Conference summary.** Clark, D.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-ENG-48. 12p. (CONF-751048—8). Dep. NTIS $3.50.

From International conference on heavy ion sources; Gatlinburg, Tennessee, USA (27 Oct 1975).

A brief review is given of the main results presented at the International Conference on Heavy Ion Sources, October 27—30, 1975. The sections are as follows: highlights, general observations, fundamental processes in sources, positive ion sources, negative ion sources, beam formation and emittance measurements, stripping, accelerators and experiments, and future prospects. (auth)

EXPERIMENTAL FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 11794

11333 (ANL-HEP-TR—76-02) **Polarized proton target-IV. Operations manual.** Hill, D.; Fletcher, O.; Moretti, A.; Onesto, F. (Argonne National Lab., Ill. (USA)). Jan 1976. Contract W-31-109-Eng-38. 61p. Dep. NTIS $4.50.

Standard operating procedures are presented for the vacuum, cryogenic, and electronic systems of a polarized proton target. The systems are comprised of (1) a target cryostat; (2) a ^{4}He pumping system; (3) a ^{3}He pumping system; (4) a microwave system; (5) a magnet and power supply; (6) a computerized polarization monitor; and (7) miscellaneous auxiliary equipment. (PMA)

11334 (CONF-750968—3) **Beam heating of target foils.** Corwin, W.C. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 14p. Dep. NTIS $3.50.

From 4. annual international conference of the Nuclear Target Development Society; Argonne, Illinois, USA (29 Sep 1975).

A target rotator, built to reduce the effects of beam spot heating, is fully adjustable, holds three targets, is chamber independent, and takes up limited space. The expected temperature rise in the target is calculated from the Stefan—Boltzmann law. (PMA)

11335 (CONF-750968—4) **Target vacuum storage facility.** Worthington, J.N.; Jedlowski, R.J.; Thomas, G.E. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 11p. Dep. NTIS $3.50.

From 4. annual international conference of the Nuclear Target Development Society; Argonne, Illinois, USA (29 Sep 1975).

A storage facility was constructed and is now in operation for use with targets which must be kept in a vacuum. The storage chamber of this facility will handle up to ninety targets at a pressure of 5×10^{-7} torr. Typically, targets are evaporated, moved into a small transfer chamber, and then placed in the storage chamber of the facility—all under vacuum. There are safety devices which minimize accidents. (auth)

11336 (CONF-750968—5) **Targets for high-resolution studies with heavy-ion reactions.** Erskine, J.R. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 30p. Dep. NTIS $4.00.

From 4. annual international conference of the Nuclear Target Development Society; Argonne, Illinois, USA (29 Sep 1975).

Target problems in heavy ion reaction studies are discussed, including non-uniformity in thickness effects and the inability to fully compensate for reaction-site effects, both problems becoming more serious the heavier the ion. For the non-uniformity effects, the flatness of the target is very critical. Other problems not yet solved are beam-spot heating and the buildup of carbon. (PMA)

11337 (CONF-750968—7) **Preparation of calcium-separated isotope targets using small samples.** Thomas, G.E. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 17p. Dep. NTIS $3.50.

From 4. annual international conference of the Nuclear Target Development Society; Argonne, Illinois, USA (29 Sep 1975).

Targets are routinely evaporated using a few milligram quantities of separated isotopes of calcium with reducing agents. The source to target distance is 3.0 cm with the substrate, if necessary, as thin as 15 μg/cm² carbon or 100 μg/cm² of gold. A tantalum closed boat, heat shield, and special collimator system are used. (auth)

11338 (CONF-750968—8) **Thin foils for beam-foil spectroscopy.** Berry, H.G. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 16p. Dep. NTIS $3.50.

From 4. annual international conference of the Nuclear Target Development Society; Argonne, Illinois, USA (29 Sep 1975).

Two effects are discussed. The first involves comparing the breakage of carbon foils (5 μg cm^{-2}) under impact of focused and non-focused beams. Under defocused beam conditions produced by x and y sweeping at frequencies of 1 kHz across the 25 mm² foil, breakage was reduced by a factor of 5 to 10. Secondly, we discuss the effect of tilting thin foils relative to incoming heavy-ion beams. The final surface interactions change drastically giving rise to changes in the excited heavy ion products. (auth)

11339 **Method of measuring a profile of the density of charged particles in a particle beam.** Hyman, L.G.; Jankowski, D.J. (to U.S. Energy Research and Development Administration). US Patent 3,911,280. 7 Oct 1975. Filed date 11 Apr 1974. 8p.

PAT-APPL-460,228.

A profile of the relative density of charged particles in a beam is obtained by disposing a number of rods parallel to each other in a plane perpendicular to the beam and shadowing the beam. A second number of rods is disposed perpendicular to the first rods in a plane perpendicular to the beam and also shadowing the beam. Irradiation of the rods by the beam of charged particles creates radioactive isotopes in a quantity proportional to the number of charged particles incident upon the rods. Measurement of the radioactivity of each of the rods provides a measure of the quantity of radioactive material generated thereby and, together with the location of the rods, provides information sufficient to identify a profile of the density of charged particles in the beam.

11340 **Simple tape vacuum seal for quick sample removal from high vacuum.** Carter, H.K.; Mlekodaj, R.L. (UNISOR, Oak Ridge, Tenn. (USA)). *Nucl. Instrum. Methods;* **128**: No. 3, 611-613(15 Oct 1975).

A simple vacuum seal has been developed that allows a tape to be pulled from (less than 10^{-6} torr) into atmosphere with only a small change in high-vacuum pressure. (NL)

11341 **Track sensitive targets: further step forward at Argonne.** *CERN Cour.;* **16**: No. 2, 47-49(Feb 1976).

A brief summary is given of the operation of the track sensitive target (TST) in the Argonne 12 foot bubble chamber, a program involving a high degree of international collaboration. The design principles, problems with development, and a bubble chamber picture are presented. (PMA)

STORAGE RINGS

REFER ALSO TO CITATION(S) 11306, 11307

11342 (BNL—50469) **Exotic rf systems for high intensity high energy proton storage accelerators.** Claus, J.; Month, M. (Brookhaven National Lab., Upton, N.Y. (USA)). 5 Sep 1975. Contract E(30-1)-16. 19p. Dep. NTIS $3.50.

High performance proton storage accelerators require the handling of intense particle beams. The transfer of a high current, low energy beam from a current accumulator ring, i.e., one of small circumference, to a large circumference ring capable of accelerating the beam to high energy, is an example. In order to prevent the longitudinal dilution which results from allowing such a beam to debunch, an rf waveform which would contain the beam azimuthally in the large ring, while at the same time being matched to the debunched beam in the small ring, is proposed. The contain-

ment is obtained by requiring that the gap voltage be reduced to zero for a large fraction of the time, this fraction being closely related to the fraction of azimuth within which the beam is to be contained. Both containment and acceleration are considered, with particular reference to the ISABELLE design parameters. (auth)

11343 (BNL—50470) **Scheme for current accumulation in ISABELLE using a low energy stacking ring.** Month, M. (Brookhaven National Lab., Upton, N.Y. (USA)). 3 Oct 1975. Contract E(30-1)-16. 27p. Dep. NTIS $4.50.

A scheme for the accumulation of current in ISABELLE is proposed. The steps in the procedure are as follows: (1) The 200-MeV linac at BNL would operate with a short pulse. One turn would be injected into the AGS, accomplished with a fast kicker in the AGS appropriate for the deflection of the 200 MeV beam. (2) The single turn pulse would be captured pseudoadiabatically and then accelerated. The resulting 12 bunches would be extracted at 29.4 GeV. A fast kicker rising between bunches would be used for this purpose. (3) The bunches would be matched and synchronously transferred to the stacking ring (SR) where sufficient current would be accumulated by the phase displacement technique used at the ISR. (4) The intense coasting beam in the SR would be rebunched into a single bunch and transferred to ISABELLE. The same fast kicker could be used for both injection into and ejection out of the SR. (5) A few such bunches would be stacked azimuthally in the ISA to achieve the final ISABELLE current. The details of the procedure are discussed, emphasizing the critical factors and significant parameters at each step. The key focal points are at 200 MeV where a space charge limitation on betatron density is encountered and at 29.4 GeV where limitations on the beam's longitudinal characteristics arise. The design procedure is given in general terms, and sample computations appropriate for ISABELLE are performed. (auth)

11344 (BNL—50471) **Alternate stacking scheme for ISABELLE.** Raka, E.C.; Hahn, H. (Brookhaven National Lab., Upton, N.Y. (USA)). 20 Oct 1975. Contract E(30-1)-16. 18p. Dep. NTIS $3.50.

An alternate mode of operating the AGS as an injector for ISABELLE is proposed. The required Z/n for the storage ring would thereby be increased to approximately 17.3 Ω from the present estimate of 4.6 Ω. The use of an intermediate stacking ring is also considered and the inherent limitations in increasing the required Z/n at injection are discussed. (auth)

11345 (BNL—50487) **ISA "split pole" injection magnet.** Parzen, G.; van Steenbergen, A. (Brookhaven National Lab., Upton, N.Y. (USA)). Aug 1975. Contract E(30-1)-16. 14p. Dep. NTIS $4.50.

The conceptual design for a shutterless "split pole" vertical deflecting dipole magnet for ISA beam injection is presented. Preliminary results of field mesh calculations are given together with measured data for a simple dc model. The results warrant proceeding with the further design and construction of a fast pulsed ferrite vertical injection kicker model for the ISA. (auth)

INSTRUMENTATION

RADIATION INSTRUMENTATION

REFER ALSO TO CITATION(S) 11456

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 10636, 10667, 11136, 11437, 11504, 11505, 11507, 11609, 11660, 12039

11346 (AD/A—008149) **Lead shield to improve detection of high-energy photons of 38 keV and 42 keV by scintillation cameras. Technical note.** Stevenson, J.S. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Oct 1974. 16p. (AFRRI-TN—74-9). NTIS $3.25.

A lead shield was designed and tested for use with the pinhole collimator of the Nuclear-Chicago HP scintillation camera to detect photons of 38 K and 42 K for cardiac scanning. A discussion of each isotope with reference to cardiac scanning is given with special emphasis on the problems of imaging high-energy photons, i.e., 511 keV or higher with the presently available scintillation cameras. (GRA)

11347 (ANL—75-60(Pt.2), pp 137-145) **Radon monitor for the vault.** May, H.A.; Miranda, J. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

A monitor for continuous recording of radon daughter concentration in the underground vault is described. The fraction of daughters attached to aerosol particles are collected on a fixed filter paper which is viewed by a ZnS(Ag) scintillator and photomultiplier tube. Results are displayed (as counts per minute) on a three decade logarithmic count rate meter. The observed count rate is much lower than would be predicted from known radon levels. Possible reasons for the low efficiency are discussed. (auth)

11348 (EGG—1183-2332) **Nuclear radiation measurement using Cherenkov light generated in a light guide.** Doyle, J.E.; Nelson, M.A.; Davies, T.J.; Franks, L.A. (EG and G, Inc., Santa Barbara, Calif. (USA)). Nov 1975. 6p. (CONF-751116—26). Dep. NTIS $3.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

Cherenkov light pulses were generated in one end of 100-m lengths of multi-fiber cable and a single strand of graded index fibers by a 50-ps burst of 18-MeV electrons. Pulse dispersion in this length was between 3.5 and 2.9 ns for the cabled fibers and 4.1 ns in the single fiber. By narrow band optical filtering, the dispersion was reduced to values between 610 and 246 ps in the cable and 400 ps for the single fiber. Cherenkov sensitivity was measured for two of the fibers and found to be 6 x 10^{12} photons/sec and 6 x 10^{13} photons/sec for 50 ps electron bursts of 10 A/cm^2 and 6 A/cm^2 respectively. In terms of time response and sensitivity it appears feasible to design a nuclear explosive diagnostic system utilizing Cherenkov radiation generated in and transmitted by cables of graded index fibers. (auth)

11349 (EUR—5370e, pp 29-31) **Fast electronics for a metastable superconducting detector.** Chase, R.L. (Brookhaven National Lab., Upton, NY); Gruhn, C.; Hrisoho, A.; Valette, C.; Waysand, G. Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In Proceedings of 2nd Ispra nuclear electronics symposium.

A room temperature electronic device for the utilization of superheated superconducting granules as particle detectors is described. (auth)

11350 (K—1882) **Evaluation of a 4π neutron counter for the nondestructive analysis of uranium-234 in uranium hexafluoride.** Mullins, W.T. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 15p. Dep. NTIS $8.50.

A neutron counter has been evaluated for the nondestructive analysis of ^{234}U in uranium hexafluoride. The instrument was designed by Los Alamos Scientific Laboratory for the Nuclear Safeguards Program. The method assumes that the only source of neutrons is from ^{19}F(α, n)^{22}Na reaction from ^{238}U, ^{235}U, and ^{234}U, the yield from ^{234}U being the most abundant. This evaluation shows that the mean of the difference between the 4 π neutron counting method and mass spectrometry is 0.0002 wt percent uranium-234 +- 0.00015 at the 95 percent confidence level. However, the presence of ^{232}U produces significant errors in the system. If the neutron technique is to be used for samples containing ^{232}U in equilibrium with its daughters, the 2.61-MeV gamma peak of ^{208}Tl must be measured and used to correct for the ^{232}U. It has been postulated that the neutron counter might also be used to relate the ^{234}U content of a sample to the ^{235}U, thus estimating the ^{235}U concentration. This evaluation notes, however, that in a variety of uranium feeds and enriched product, the ^{234}U/^{235}U ratio varies too widely to enable a valid ^{235}U determination.

11351 (LBL—4632) **High efficiency collimator-converters for neutral particle imaging with MWPC.** Chu, D.; Tam, K.C.; Perez-Mendez, V.; Lim, C.B.; Lambert, D.; Kaplan, S.N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1975. Contract W-7405-Eng-48. 9p. (CONF-751116—22). Dep. NTIS $3.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

A MWPC with external collimator converter system has been developed specifically for the detection of 0.511 MeV gammas in a positron camera. The design basis is applicable also to the imaging of other gammas and neutrons. The converter consists of honeycomb cells which provide an enhanced area of escape surface as well as restricting the range of conversion electrons to the cell dimensions. (WHK)

11352 (UCSD—34P220X2) **Role of secondary particles in the ionization process. Progress report, January 1—December 31, 1975.** Baily, N.A. (California Univ., San Francisco (USA). Dept. of Radiology). 1975. Contract E(04-3)-34. 19p. Dep. NTIS $3.50.

Work over the past year on testing and improvement of the multiwire proportional chamber is reviewed. Accomplishments in-

clude a reduced absolute noise level, a study on the counting rate, measurement of resolution, improved preamplifier performance, acquired more preliminary data using α particles, calculated the gas gain vs pressure and high voltage, investigated the performance of the MWPC at low pressures (approximately 1 torr), and made changes in wire spacing and the spacing between planes to optimize the relationship between gas gain and particle pathlength. Preparations for machine runs at UCLA and Berkeley are summarized. (WHK)

11353 Identification of nuclear particles. Goulding, F.S.; Harvey, B.G. (Univ. of California, Berkeley). *Annu. Rev. Nucl. Sci.*; **25**: 167-240(1975).

Identification by absorption in a detector telescope, time-of-flight identifiers, and systems involving magnetic rigidity are discussed. 168 references. (WHK)

11354 Window for radiation detectors and the like. Sparks, C.J. Jr.; Ogle, J.C. (to U.S. Energy Research and Development Administration). US Patent 3,916,200. 28 Oct 1975. Filed date 4 Sep 1974. 4p.

PAT-APPL-503,121.

An improved x- and gamma-radiation and particle transparent window for the environment-controlling enclosure of various types of radiation and particle detectors is provided by a special graphite foil of a thickness of from about 0.1 to 1 mil. The graphite must have very parallel hexagonal planes with a mosaic spread no greater than 5° to have the necessary strength in thin sections to support one atmosphere or more of pressure. Such graphite is formed by hot-pressing and annealing pyrolytically deposited graphite and thereafter stripping off layers of sufficient thickness to form the window.

11355 Background compensation for a radiation level monitor. Keefe, D.J. (to U.S. Energy Research and Development Administration). US Patent 3,924,106. 2 Dec 1975. Filed date 31 Oct 1974. 6p.

PAT-APPL-519,491.

Background compensation in a device such as a hand and foot monitor is provided by digital means using a scaler. With no radiation level test initiated, a scaler is down-counted from zero according to the background measured. With a radiation level test initiated, the scaler is up-counted from the previous down-count position according to the radiation emitted from the monitored object and an alarm is generated if, with the scaler having crossed zero in the positive going direction, a particular number is exceeded in a specific time period after initiation of the test. If the test is initiated while the scale is down-counting, the background count from the previous down-count stored in a memory is used as the initial starting point for the up-count.

11356 X-ray image intensifier phosphor. D'Silva, A.P.; Fassel, V.A. (to U.S. Energy Research and Development Administration). US Patent 3,925,674. 9 Dec 1975. Filed date 30 Jan 1973. 4p.

PAT-APPL-327,899.

Y/sub 1-x/Gd/sub x/.PO_4:Tb^{3+} is an effective phosphor for use in X-ray intensifier screens and in nuclear radiation detection systems.

11357 Method of producing thin cellulose nitrate film. Lupica, S.B. (to U.S. Energy Research and Development Administration). US Patent 3,928,700. 23 Dec 1975. Filed date 30 May 1974. 4p.

PAT-APPL-474,554.

An improved method for forming a thin nitrocellulose film of reproducible thickness is described. The film is a cellulose nitrate film, 10 to 20 microns in thickness, cast from a solution of cellulose nitrate in tetrahydrofuran, said solution containing from 7 to 15 percent, by weight, of dioctyl phthalate, said cellulose nitrate having a nitrogen content of from 10 to 13 percent.

11358 Areal detection efficiency of channel electron multiplier arrays. Panitz, J.A.; Foesch, J.A. (Sandia Laboratories, Albuquerque, New Mexico 87115). *Rev. Sci. Instrum.*; **47**: No. 1, 44-49(Jan 1976).

The areal detection efficiency of a channel electron multiplier array (CEMA) and the nature of its secondary emission surface were investigated with the ion microprobe mass analyzer (IMMA). Previous speculations of detection efficiency based on simple geometric arguments of channel-to-interchannel area ratios are shown to be in error. With a positive bias applied to a front electrode surface of high secondary yield, areal detection efficiency of a CEMA may approach 100% even for single-ion impacts. The secondary emission properties of a CEMA are shown to be determined by an alkali-rich surface layer on each channel wall, and not a concentration of Pb or PbO as previously thought. Both reversible and irreversible gain degradation observed when heating a CEMA in vacuum are interpreted as a change in the composition of this layer. (AIP)

RADIATION DOSEMETERS

11359 (AD/A—006678) **Thermally stimulated current dosimetry. Final report, 10 Apr 73-30 Jun 74.** Gates, D.C.; Krehl, P.; Magee, T.J.; Armistead, R.A. (Stanford Research Inst., Menlo Park, Calif. (USA)). 24 Jan 1975. Contract DNA001-73-C-0252. 47p. NTIS $3.75.

This report describes an experimental program to develop a radiation dosimeter system based upon the measurement of thermally stimulated conductivity (TSC) in dielectric materials. These materials spanned a broad range of atomic numbers and included MgF_2, SiO_2, CaF_2, CaF_2:Dy, SrF_2, Y_2O_3:ThO_2, $LiNbO_3$, BaF_2, HfO_2, Ta_2O_5, ThO_2, ThO_2:CaO, Mylar and Lucite. The TSC of materials exposed to ^{60}Co gamma radiation was measured during heating at linear rates to a maximum temperature of 450°C. Prominent TSC peaks were observed with ThO_2, Y_2O_3:ThO_2, and the plastics. The authors believe that the desirable dosimeter qualities of reusability and reproducibility can be attained with carefully fabricated doped crystals or with mixed polycrystals that are annealed near their melting temperatures. (GRA)

11360 (CONF-760301—1) **Intercomparison of personnel dosimeters.** Dickson, H.W.; Fox, W.F.; Haywood, F.F. (Oak Ridge National Lab., Tenn. (USA)). 1974. 8p. Dep. NTIS $3.50.

From NBS symposium on measurements for the safe use of radiation; Gaithersburg, Maryland, United States of America [USA] (1 Mar 1976).

An intercomparison of personnel monitoring dosimeters was conducted at Oak Ridge National Laboratory's DOSAR Facility. Ten independent laboratories and companies participated in an intercomparison of neutron and gamma-ray dosimeters used for routine personnel dosimetry. The dosimeters, which were sent through the mail, were exposed at the Health Physics Research Reactor to the same three "standardized" radiation fields which have been used for the past several years for intercomparing nuclear accident dosimeters. In addition, a 14-MeV neutron field was used as a fourth exposure condition. The results of the intercomparison show widely varying dose estimates. The reported values of neutron dose equivalent, for example, have standard deviations ranging from 47 to 102 percent of the mean. (auth)

11361 Computational extension of the dynamic range of TL and TSEE readers. Jun, J.S.; Talmage, J.E.; Becker, K. (Oak Ridge National Lab., Tenn. (USA)). *Nucl. Instrum. Methods*; **129**: No. 1, 247-250(1 Nov 1975).

In situations in which the measurability of thermoluminescence or exoelectron emission glow curves is limited by the characteristics of the readout instrument (e.g., saturation in proportional or gas counters), the peak can be "reconstructed" as if it were recorded in full by proper evaluation of the reliably recorded low-T and high-T segments of the peak. The results of two different methods have been compared, assuming (a) a Gaussian shape or (b) linear scaling of the glow curves, with a parabolic shape at the low-T and a linear shape at the high-T side. The procedures are simplified by using the combination of a digitizer and a programmable calculator. The usable dynamic range of various radiation dosimeters can thus be extended by about two orders of magnitude. (NL)

11362 New "wall-less" ionization chamber for air dose measurement. Varma, M.N.; Baum, J.W. (Health Physics and Safety Division, Brookhaven National Laboratory, Upton, New York 11973). *Rev. Sci. Instrum.*; **47**: No. 1, 112-114(Jan 1976).

A simple mesh wall ionization chamber (representing a "wall-less" ionization chamber) is described for air dose measurement. The effects of insulators and air circulation in the vicinity of the chamber were studied. An outer shield mesh placed around the collecting chamber eliminates the adverse effects of air circulation and electrostatic disturbances around the detector. The detector can be used effectively to measure that component of dose due to low energy electrons or x rays which are normally stopped by the walls of conventional dose measuring instruments. The mesh ion chamber is particularly useful in measuring dose distribution in and around a radiation field. This chamber approximates a free air ion chamber that can be used at low, as well as high, energies once electron equilibrium is achieved. The chamber was tested using ^{137}Cs gamma radiations and gives good agreement with a model 570 Victoreen R meter. (AIP)

NUCLEAR SPECTROSCOPIC INSTRUMENTAION

REFER ALSO TO CITATION(S) 12034

11363 (DP—1393) **Automated multispectra alpha spectrometer and data reduction system.** Hochel, R.C. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Dec 1975. Contract AT(07-2)-1. 16p. Dep. NTIS $4.50.

A complete hardware and software package for the accumulation and rapid analysis of multiple alpha pulse height spectra has been developed. The system utilizes a 4096-channel analyzer capable of accepting up to sixteen inputs from solid-state surface barrier detectors via mixer-router modules. The analyzer is interfaced to a desk-top programmable calculator and thermal line printer. A chained software package including spectrum printout, peak analysis, plutonium-238 and plutonium-239 data reduction, and automatic energy calibration routines was written. With the chained program a complete printout, peak analysis, and plutonium data reduction of a 512-channel alpha spectrum are obtained in about three minutes with an accuracy within five percent of hand analyses. (auth)

11364 (EUR—5370e, pp 47-65) **Accurate measurement of noise parameters in ultra-low noise opto-feedback spectrometer systems.** Llacer, J. (Univ. of California, Berkeley). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In Proceedings of 2nd Ispra nuclear electronics symposium.

The accurate measurement of the basic noise parameters of ultra-low noise spectrometer systems has been developed in the frequency domain by spectrum analysis. This method overcomes some of the difficulties experienced in using conventional techniques. An analytic and experimental comparison between "time" and frequency domain techniques is carried out and the use of the latter as a method to develop extremely low-noise detector and FET packages is demonstrated. The origin of the remaining noise in high quality systems is traced to surface and gate junction generation through traps in the FET. (auth)

11365 (RD/B/N—3443) **Spectroscopy section data acquisition system at CEGB, Berkeley Nuclear Laboratories.** Swallow, G.A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1975. 17p. Dep. NTIS (US Sales Only) $3.50.

The first version of a software package designed to take data from the various instruments in the spectroscopy section is described. It describes the program philosophy, the instruments serviced, and contains a comprehensive guide to the use of the program. The system operates on a Varian 620L minicomputer and data can be output in a form suitable for further analysis on the IBM 370 computer if necessary. (auth)

11366 (UCRL—77151) **Charged-particle magnetic-quadrupole spectrometer for neutron induced reactions.** Haight, R.C.; Grimes, S.M.; Tuckey, B.J.; Anderson, J.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Dec 1975. Contract W-7405-Eng-48. 28p. (CONF-751088—1). Dep. NTIS $4.00.

From APS meeting; Austin, Texas, United States of America [USA] (30 Oct 1975).

A spectrometer has been developed for measuring the charged particle production cross sections and spectra in neutron-induced reactions. The spectrometer consists of a magnetic quadrupole doublet which focuses the charged particles onto a silicon surface barrier detector telescope which is 2 meters or more from the irradiated sample. Collimators, shielding, and the large source-to-detector distance reduce the background enough to use the spectrometer with a 14-MeV neutron source producing 4 . 10^{11} n/s. The spectrometer has been used in investigations of proton, deuteron, and alpha particle production by 14-MeV neutrons incident on various materials. Protons with energies as low as 1.1 MeV have been measured. The good resolution of the detectors has also made possible an improved measurement of the neutron-neutron scattering length from the 0° proton spectrum from deuteron breakup by 14-MeV neutrons. (auth)

11367 **Versatile multipole correction magnet of rectangular aperture.** Peterson, R.J.; Kraushaar, J.J.; Ristinen, R.A. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.); Thiessen, H.A. (Los Alamos Scientific Lab., N.Mex. (USA)); Rickey, M.E. (Indiana Univ., Bloomington (USA). Dept. of Physics). *Nucl. Instrum. Methods;* **129**: No. 1, 47-51(1 Nov 1975).

A rectangular aperture multipole magnet in which multipole components are independently variable has been designed and constructed. This magnet is intended for use as an adjustable trim element in a precision spectrometer system. No organic materials are used in the assembly, and the magnet is suitable for use in a high radiation environment. (NL)

HIGH ENERGY PHYSICS INSTRUMENTATION

11368 (CONF-7509108—1) **15-foot bubble chamber characteristics.** Huson, F.R. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). 15 Sep 1975. 66p. Dep. NTIS $5.50.

From Fermilab symposium on hadrons in bubble chambers; Batavia, Illinois, United States of America [USA] (18 Sep 1975).

Specifications, operation, characteristics, cost, and experience with the NAL 15-ft bubble chamber are described. Beam availability and some experimental proposals are discussed. (WHK)

11369 (EUR—5370e, pp 1-8) **Particle identification by processing of signals from multiple detectors.** Gatti, E.; Radeka, V.; Rosenblum, M. (Brookhaven National Lab., Upton, NY). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In Proceedings of 2nd Ispra nuclear electronics symposium.

It is shown that for particle identification it is convenient to develop instrumentation based on coding the output of the detectors according to the ratio of probabilities that a particular signal is given by the two kinds of particles considered. Particular emphasis has been given to uncorrelated responses of each detector of a set, but the case of correlated responses leads to obvious extensions of the ideas presented. (auth)

11370 (EUR—5370e, pp 349-354) **New developments in the magnetostrictive readout system at SLAC.** Bertolucci, B. (Stanford Linear Accelerator Center, CA). Jun 1975.
From ISPRA symposium; Stresa, Italy (20 May 1975).
In Proceedings of 2nd Ispra nuclear electronics symposium.

The present paper describes the work done at SLAC for the magnetostrictive wire spark chambers of SPEAR, LASS and the two-meter streamer chamber. All three are CAMAC systems based on the use of a time digitizer module with different interfacing techniques into three different computers (Sigma 5, PDP-9, PDP-11). Of particular interest is a display controller module that permits wide selection of the data to be displayed. (auth)

11371 (ORNL/TM—5105) **Calculated performance of iron—argon and iron—plastic calorimeters for incident hadrons with energies of 5 to 75 GeV.** Gabriel, T.A.; Schmidt, W. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 43p. Dep. NTIS $5.50.

The calculated responses of iron—argon and iron—plastic calorimeters for incident hadrons with energies of 5 to 75 GeV are presented. The responses calculated are energy resolution vs energy, energy resolution vs the thickness of the sampling plates, the angular and spatial root-mean-square deviations (i.e., the ability to determine the incident particle's entrance angle and impact point), and the spatial properties of the average and individual hadronic cascades. Some comparisons are made with experimental data; however, the main purpose of this paper is to provide specific design information for these types of calorimeters.

11372 **Computer interfacing for high-energy physics experiments.** Kristen, F.A. (Lawrence Berkeley Lab., CA). *Annu. Rev. Nucl. Sci.;* **25**: 509-554(1975).

The intent of this article is to outline the factors that influence the choice or design of the data-handling components, and their organization into systems useful for a class of high-energy physics experiments. The class is the one sometimes described by that rather loose term, "on-line." It includes those experiments in which data are acquired electrically, and analyzed or recorded by electrical means. (auth)

11373 **Cherenkov threshold-differential spectrometer.** Dibianca, F.A.; Dunaitsev, A.F.; Kolganov, V.Z.; Mukhin, A.I.; Nezrick, F.A.; Sittler, F. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). *Nucl. Instrum. Methods;* **129**: No. 1, 59-63(1 Nov 1975).

A new type of threshold-differential Cherenkov spectrometer has been developed to measure the flux and momentum distribution of high intensity charged particle beams in an intense charged particle background. The spectrometer is intended primarily for use in monitoring and measuring the properties of wide-band neutrino beams by measuring the associated decay muon spectrum. The spectrometer has been tested in a beam of 300 GeV/c protons and found to have 8 percent momentum resolution, 2 mrad angular resolution and 0.1 percent efficiency. (NL)

11374 **400 GeV shower counter.** Knauer, J.P.; Yount, D.E. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). *Nucl. Instrum. Methods;* **129**: No. 1, 91-94(1 Nov 1975).

Specifications and test data are given for a lead-scintillator electromagnetic shower counter used to detect beam photons at Fermi National Accelerator Laboratory. The response is independent of beam position to +- 1.4 percent rms over a 25 x 25 cm area. Shower penetration losses reach 4.1 percent at 250 GeV but are easily calculable. The resolution is limited almost entirely by fluctuations in the number of shower tracks samples: The full-width-at-half-maximum is approximately 43 percent E/sup $1/2$/, where E is the incident energy in GeV. (NL)

RADIOMETRIC INSTRUMENTS

REFER ALSO TO CITATION(S) 10306

11375 Ion scattering spectrometer utilizing charge exchange processes. Erickson, R.L.; Smith, D.P. (to Minnesota Mining and Manufacturing Co.). US Patent 3,920,989. 18 Nov 1975. Filed date 20 Sep 1974. 12p.

An ion scattering spectroscopic method and apparatus are described wherein an oscillatory variation in the yield of ions scattered from solid surfaces provides information indicative of electron exchange processes associated with particular electronic states in the atom, which states vary with the electronic environment surrounding the atoms. The apparatus includes means for directing a beam of ions having a known mass and a known charge state toward a solid target surface such that an ion impinges thereon and scatters therefrom. During the impingement, the energy of the incident ions is varied over a range of predetermined primary ion kinetic energies. Ions having a given primary kinetic energy prior to impingement lose a given fraction of that energy upon elastic scattering from an atom of given atomic mass on the target surface. Accordingly, ions scattered from atoms of a single atomic mass are continuously detected by synchronously "tracking" the acceptance energy of an analyzer with the variation in the kinetic energy of the incident ions. A signal indicative of the yield of ions scattered from atoms having a single atomic mass is thus produced and when plotted as a function of incident primary ion kinetic energy, forms a spectrum wherein particular electronic states may be discerned. (auth)

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

11376 (AD/A—005590) **Nuclear radiation testing of diodes, silicon controlled rectifiers, transistors and integrated circuits. Technical report.** Cassidy, E.T. (Picatinny Arsenal, Dover, N.J. (USA)). Dec 1974. 76p. (PA-TR—4692). NTIS $4.75.

Extensive nuclear radiation tests were conducted on various types of diodes, transistors, silicon controlled rectifiers, DTL and CMOS integrated circuits for use in digital electronics. The nuclear radiation effects considered during this test program were endoatmospheric, i.e., neutron and gamma dose rates. The digital electronics employing the semiconductors tested are used in either ground systems or low-flying missiles, therefore, no exoatmospheric effects such as x-rays were evaluated. The report documents the components tested, test methods, radiation test facilities used and the test results for each component tested. (GRA)

11377 (AD/A—005617) **Component damage/malfunction levels. Final report.** (Boeing Aerospace Co., Seattle, Wash. (USA)). Dec 1974. Contract DACA87-72-C-0002. 96p. (TM—15). NTIS $4.75.

Damage/malfunction thresholds for mission-critical EMP-sensitive equipment of the SAFEGUARD Tactical Support Equipment have been determined by analysis and by laboratory tests. For inductive components and equipments insulation breakdown is the damage mechanism. For equipment containing solid-state semiconductors burnout of the sensitive piecepart governs. For low-voltage capacitors overvoltage at the capacitor is the damage mechanism. Methods used to calculate the damage/malfunction thresholds are given and a summary of the laboratory test results is presented. (GRA)

11378 (AD/A—005618) **RFI filter evaluation. Final report.** (Boeing Aerospace Co., Seattle, Wash. (USA)). Dec 1974. Contract DACA87-72-C-0002. 48p. (TM—80). NTIS $3.75.

EMP isolation provided by RFI filters in the SAFEGUARD North Dakota site is evaluated. A mathematical model of typical filters is developed. Comparisons with manufacturing acceptance specifications and with test measurements onsite are used to confirm the model. Isolation of EMP transients in the SAFEGUARD installation is shown to be at least 50 dB. (GRA)

11379 (AD/A—005621) **Empirically derived transfer functions threat environment to internal environment (s-zone) RLOB. Final report.** (Boeing Aerospace Co., Seattle, Wash. (USA)). 4 Dec 1974. Contract DACA87-72-C-0002. 27p. (TM—84). NTIS $3.75.

Magnetic-field transfer functions for outside-to-inside test positions are presented. The transfer functions were determined from the RLOB Site Test 5 test data. In addition, comparison is made between transfer functions derived from test data and calculated transfer functions. (GRA)

11380 (AD/A—005622) **Surge suppressor isolation devices. Technical memo.** (Boeing Aerospace Co., Seattle, Wash. (USA)). Dec 1974. Contract DACA87-72-C-0002. 44p. (TM—86). NTIS $3.75.

A theoretical and empirical analysis was conducted to determine the effectiveness of surge capacitors and surge arrestors in suppressing EMP-induced transients. The attenuation was found to be only 3 dB for a 10 nanosecond risetime pulse and 9 dB for a 100 nanosecond risetime pulse. For slower pulses the surge arrestors and capacitors operated normally. (GRA)

11381 (AD/A—005623) **Empirically derived transfer functions threat environment to internal environment (s-zone) MSPP. Final report.** (Boeing Aerospace Co., Seattle, Wash. (USA)). 4 Dec 1974. Contract DACA87-72-C-0002. 28p. (TM—88). NTIS $3.75.

Magnetic-field transfer functions for outside-to-inside test positions are presented. The transfer functions were determined from the MSPP Site Test 7 test data. In addition, comparison is made between transfer functions derived from test data and calculated transfer functions. (GRA)

11382 (AD/A—005624) **Alert attack switch isolation. Technical memo.** (Boeing Aerospace Co., Seattle, Wash. (USA)). Dec 1974. Contract DACA87-72-C-0002. 41p. (TM—89). NTIS $3.75.

The transients on the internal (to the facilities) portion of soft circuits due to their external EMP pickups can adversely affect the critical hardware performance either directly through introduction of perturbations to the power bus(es) they are connected to, or indirectly through cross-coupling to totally unrelated circuits which are in their physical proximity. The Alert Attack Switch (AAS) system disconnects external soft circuits, thereby providing protection to internal, critical subsystems from the EMP transients induced on external circuits. This memorandum presents a mathematical description relating the input (external) and output (internal) EMP transient, on a circuit across an activated (open) alert attack switch. From the results the internal transient can be computed adequately for any given external transient wave shapes. Results of calculations are also presented for external transients of the double exponential type with time constants of interest. (GRA)

11383 (AD/A—009594) **Extended SCEPTRE. Volume I. User's manual. Final report, 15 May 1972—30 June 1974.** Becker, D. (GTE Sylvania, Inc., Needham Heights, Mass. (USA)). Dec 1974. Contract F29601-72-C-0093. 248p. NTIS $7.50.

See also Volume 2, Dec 1974, AD/A—009595.

Volume 1 of Extended SCEPTRE covers circuit preparation and entry and describes the use of the special program options including: stored model; re-output, continue and rerun; the sub-program capability; and the various print and plot options. Examples of the use of the old and new features are given. Separate chapters contain system information for using SCEPTRE on the 7090/94 and S/360 machines. CDC 6600 system information and additional notes to the user are contained in volume 1, appendixes G and H respectively. (GRA)

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 10258, 10259, 10260, 10261, 10262, 10263, 10264, 10273, 10526, 10538, 10622, 10623, 10624, 10625, 10626, 10627, 10628, 10635, 10640, 10713, 11216, 11236, 11455, 11763, 12317

11384 (AD/A—006980) **Stress gage system for the megabar range. Final report, 2 Apr 1973-30 Jun 1974.** De Carli, P.S. (Stanford Research Inst., Menlo Park, Calif. (USA)). Jun 1974. Contract DNA001-73-C-0225. 45p. NTIS $3.75.

The report covers a one-year study of the feasibility of measuring stress wave profiles in the megabar range. The primary objective was accomplished with the successful manganin gage recording of a 1.2 megabar stress wave profile, including release to zero stress. The conductivities of various insulators were measured at shock stresses of 700-800 kbar. Lucalox (Al_2O_3 ceramic), fused silica, and a Cabal glass were excellent insulators in this stress range. The electrical resistivity of epoxy at high shock stresses was improved by adding Al_2O_3 powder. The mutual inductance particle velocity gage did not show promise of working at very high stresses in a nuclear test environment. Further developmental work is suggested. (GRA)

11385 (AERE-R—8240) **Data processing facilities in the Harwell 6000 Series.** Phillips, G.I.; Wakefield, G.; Hawthorn, I. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jan 1976. 30p. Dep. NTIS (US Sales Only) $4.00. UK pounds1.50.

The Harwell 6000 Series modular unit scheme has already been described in general terms; the reports also cover a wide variety of systems which have been assembled from that range of units. The data processing facilities are described in more detail in this report, with emphasis on the read-out of data to various

recording devices ranging from Strip printer to minicomputer, and the readsin of data from peripheral devices to systems stores. 18 figures, 1 table (auth)

11386 (EUR—5370e) **Proceedings of 2nd Ispra nuclear electronics symposium, Stresa, Italy, May 20—23, 1975.** (Commission of the European Communities, Ispra (Italy). Joint Research Centre). Jun 1975. 459p. (CONF-750521—P1).

From ISPRA symposium; Stresa, Italy (20 May 1975).

Separate abstracts were prepared for 77 of the 85 papers for inclusion in NSA. Seven of the papers were not in scope and 1 paper was previously abstracted in NSA (32:06550). Six papers are abstracted in ERA. (WHK)

11387 (EUR—5370e, pp 245-251) **Developments in architecture for real-time data systems.** Heath, R.L.; Myers, W.R. (Aerojet Nuclear Co., Idaho Falls, ID). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In Proceedings of 2nd Ispra nuclear electronics symposium.

Real-time data systems typically operate at two levels: a fast-response instrument-oriented level for data acquisition and control, and a slow human-oriented level for interaction and computation. Traditional minicomputer data systems support real-time applications by implementation of background/foreground software. Recent developments in computer technology including microprocessors enable the functional organization of hardware in distributed or hierarchical form to provide new system structures for real-time requirements. Examples of systems with distributed architecture are discussed in detail including a remote isotopic snow gage and remote isotopic monitoring with gamma-ray spectrometry. (auth)

11388 (EUR—5370e, pp 325-331) **Applications and development of CAMAC in North America in 1975.** Mack, D.A.; Wagner, L.J. (Univ. of California, Berkeley). Jun 1975.

From ISPRA symposium; Stresa, Italy (20 May 1975).

In Proceedings of 2nd Ispra nuclear electronics symposium.

CAMAC is now a well established instrumentation system in North America. Research organizations outside of the National Laboratories and industrial users are finding that this modular instrumentation system for data handling is indeed a very practical and cost effective approach to Computer Aided Measurement And Control. Accordingly, applications of new developments in CAMAC during the past year are reviewed and its future is considered in view of related technological developments. (auth)

11389 (HEDL-TME—75-53) **Design and performance of a microwave strain measuring system for materials tests.** Billeter, T.R.; Blackburn, L.D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1975. Contract AT(45-1)-2170. 27p. Dep. NTIS $3.50.

Excellent sensitivity and accuracy in the measurement of deformation occurring in materials tests have been achieved with a newly developed microwave frequency sensor and instrumentation system with possible application for strain tests inside nuclear reactors. The strain sensor comprises a microwave cavity resonating in the circular TE 113 and TM 110 modes. Detection of axial strain occurs due to the changes of resonant frequency incurred by cavity length changes. Axial strain sensitivity for the TE 113 mode was 6×10^{-6} per MHz, whereas radial dimensions of the cavity were related to frequency of the TM 110 mode. Aperture coupling of the cavity to the end wall of K/sub a/ band waveguide provided signal excitation of the two monitored modes. Phase locked frequency stability enabled digital count/display of resonant frequencies to within 70 kHz at 35 GHz. Room temperature tension test results demonstrate a strain measuring sensitivity (+- 1 x 10^{-6}) and accuracy (+ -1 percent of the measured value) equivalent to those of electrical resistance strain gages. The system yields accurate measurements of elastic strains as well as small departures from elastic response and hysteresis behavior during unloading and reloading. Creep test results confirm that measurement sensitivity and accuracy are retained in elevated temperature tests. Strain response on loading, subsequent creep deformation and creep recovery after unloading can all be measured in detail. Stability of microwave sensor calibration after exposure for 22 x 10^6 seconds at temperatures from 728°K to 866°K is shown to be excellent.

11390 (IS-M—62) **Inductively coupled plasma-atomic emission spectroscopy: an alternative approach to "flameless" atomic absorption spectroscopy.** Fassel, V.A. (Ames Lab., Iowa (USA); Iowa State Univ. of Science and Technology, Ames (USA)). 1976. 45p. (CONF-7506118—1). Dep. NTIS $4.00.

From ASTM symposium on flameless and cold vapor atomic absorption; Montreal, Canada (22 Jun 1975).

Atomic emission spectroscopy (AES) combined with an inductively coupled plasma (ICP) excitation source is suggested as an alternative to "flameless" atomic absorption spectroscopy for the determination of trace elements in liquid samples of limited volume. The AES—ICP approach offers the potential advantage of being able to perform these determinations on a simultaneous multielement basis, and possesses an unusual degree of freedom from interelement effects if solution nebulization techniques are utilized. For one-milliliter sample volumes, the relative powers of detection (ng/ml) of the AES—ICP approach are comparable to the values reported for flameless atomic absorption procedures.

11391 (SAND—75-0426, pp 15-18) **Measurement of thermal transients.** Keltner, N.R. Feb 1976.

In Sandia technology, Autumn 1975.

It is shown that with thermal sensor response models, the accuracy of measurements from transient thermal experiments can be improved.

11392 (SAND—75-0426, pp 19-23) **Lithium niobate stress transducers.** Graham, R.A. Feb 1976.

In Sandia technology, Autumn 1975.

Investigation of lithium niobate to determine its piezoelectric properties has shown it to be well suited for use in piezoelectric stress transducers. Gages were developed and proven to be well adapted to measurements both in the laboratory and in more adverse conditions in the field.

11393 (TID—26978) **Radio-frequency induction for checking fire detectors.** Aarts, H.J.; Evans, W.B.; Utley, L.W. (Atomics International Div., Golden, Colo. (USA)). 22 Jan 1976. Contract E(29-2)-3533. 10p. Dep. NTIS $3.50.

A new method of testing fire detectors in the glove-box lines has been developed. The method includes heating the fire detector by a strong electromagnetic field which induces eddy currents in the metal case of the fire detector. Developed as a radio-frequency induction heating system, a prototype was designed and built for use with fire detectors installed at the Rocky Flats Plant. The system has been tested and operates satisfactorily. It is concluded that the system could be installed in glove boxes and could easily be automated from a central point. Applications exist for glove-box lines on site or for facilities off site. (auth)

11394 (UCID—16908) **Strain gages subjected to a high pressure hydrogen environment.** Billia, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Sep 1975. Contract W-7405-Eng-48. 10p. Dep. NTIS $4.00.

Strain gages mounted on the inside of a thick walled pressure vessel experienced apparent zero shift or hysteresis effects when the pressurizing medium was hydrogen gas at 20 kpsi. The gages worked normally and predictably when helium gas was used.

11395 **Photomultiplier tube gain regulating system.** Johnson, W.F. (to U.S. Energy Research and Development Administration). US Patent Application 566,572. Filed date 8 Apr 1975. 5p.

This invention relates to an improved system for regulating the gain of a photomultiplier tube, and was designed for use with the photomultiplier tubes of the GeMSAEC fast analyzers. It has the following advantages over the prior system: noise is virtually eliminated; sample analysis can begin after 3 to 4 revolutions of the rotor; fluorescent and light scattering solutions can be used as a reference; and the reference solution can be in any cuvette on the rotor.

11396 **Ultrasonic transducer.** Karplus, H.H.B. (to U.S. Energy Research and Development Administration). US Patent Application 565,020. Filed date 3 Apr 1975. 7p.

An ultrasonic transducer capable of use in a high-temperature environment incorporates a laminated metal coupling wedge including a reflecting edge shaped as a double sloping roof and a transducer crystal backed by a laminated metal sound absorber disposed so as to direct sound waves through the coupling wedge and into a work piece, reflections from the interface between the coupling wedge and the work piece passing to the reflecting edge. Preferably the angle of inclination of the two halves of the reflecting edge are different. (auth)

11397 **Stable isotope ratiometer—multiple ion detector unit for quantitative and qualitative stable isotope studies by gas chromatography—mass spectrometry.** Klein, P.D.; Haumann, J.R.; Hachey, D.L. (Argonne National Lab., IL). *Clin. Chem.*; **21**: No. 9, 1253-1257(Aug 1975).

From 7. annual symposium on advanced analytical concepts for the clinical laboratory; Oak Ridge, Tennessee, USA (13 Mar 1975).

See CONF-750319—.

A stable isotope ratiometer—multiple ion detector unit, which can drive existing gas chromatograph-quadrupole or magnetic sector mass spectrometers to monitor up to six ions in turn, is described. Each of the three pairs of ions can be selected for

quantitation; thus three different or successive components can be analyzed in a single gas-chromatographic run. A background subtraction option permits the ion intensity in the absence of sample to be subtracted automatically during sample measurement. Displays of accumulated counts and isotope ratio are updated twice per second during the measurement and can be printed out at its conclusion. All six ions can be monitored in the analog mode by parallel outputs to a multipen recorder. Experience gained in the construction of this prototype indicates that such units could be commercially available for $10,000, or about a third to a sixth of the cost of even an inexpensive computer system. (auth)

11398 Ion illumination angle control for a mass spectrometer. Conzemius, R.J. (to U.S. Energy Research and Development Administration). US Patent 3,911,272. 7 Oct 1975. Filed date 29 Apr 1974. 6p.
PAT-APPL-464,889.

A more efficient operation of a spark source mass spectrometer is achieved by adjusting the position of the spark gap with respect to the ion optical system as well as the spark gap width. The adjustment of the position of the spark gap provides a more nearly constant ion beam axis ion illumination angle so that a more constant instrument sensitivity is maintained.

11399 Zeeman effect absorption spectrometer. Hadeishi, T. (to U.S. Energy Research and Development Administration). US Patent 3,914,054. 21 Oct 1975. Filed date 13 Feb 1974. 12p.
PAT-APPL-442,280.

Apparatus and method that employs Zeeman reference and absorption components in a spectrometer for rapidly and accurately detecting the presence of trace amounts of a specific biologically dangerous metal element, such as Hg, that contaminates a host substance, such as food. In one embodiment for detecting Hg in fish, the method comprises heating a sample of fish containing mercury to form a vapor, transmitting a focused light spectra from a specific mercury isotope light source in a magnetic field at right angles to the light spectra, said spectra containing 2,547 A light and specific Zeeman components, comprising a component that is attenuated by the mercury in the vapor an amount corresponding to the amount of mercury in the sample and at least one reference component that is substantially unattenuated by the Hg in the vapor, filtering the transmitted focused spectra with a 2,537 A filter, splitting the filtered spectra into two beams whose intensities correspond respectively to the intensities of the attenuated and reference components, and detecting and difference of said beams as a measure of the mercury in the fish.

11400 Adjustable extender for instrument module. Sevec, J.B.; Stein, A.D. (to U.S. Energy Research and Development Administration). US Patent 3,917,369. 4 Nov 1975. Filed date 26 Aug 1974. 4p.
PAT-APPL-500,708.

A blank extender module used to mount an instrument module in front of its console for repair or test purposes has been equipped with a rotatable mount and means for locking the mount at various angles of rotation for easy accessibility. The rotatable mount includes a horizontal conduit supported by bearings within the blank module. The conduit is spring-biased in a retracted position within the blank module and in this position a small gear mounted on the conduit periphery is locked by a fixed pawl. The conduit and instrument mount can be pulled into an extended position with the gear clearing the pawl to permit rotation and adjustment of the instrument.

11401 Diagnoses of disease states by fluorescent measurements utilizing scanning laser beams. Holm, D.M. (to U.S. Energy Research and Development Administration). US Patent 3,918,812. 11 Nov 1975. Filed date 7 May 1973. 8p.
PAT-APPL-357,758.

An apparatus and method for determining the type, amount and position of antibodies and/or antigens in a biological cell is described. Dyes which affect selected antibodies and/or antigens in a particular manner are introduced into a subject cell. An exemplary single channel system moves a light beam in an X-Y scan relative to the cell. The dyed antibodies and/or antigens, when excited by specific wavelengths in the light beam, respond by fluorescing at predetermined wavelengths or absorbing certain of the specific wavelengths. The particular wavelengths fluoresced or absorbed indicate the types of antibodies and/or antigens present in the cell. The system preferably outputs to a color television system to produce a display representative of the antibody and antigen distribution in the cell by type, amount, and position. The application also discloses multichannel embodiments.

11402 Potential sensing cell analyzer. Salzman, G.C.; Coulter, J.R.; Mullaney, P.F.; Hiebert, R.D. (to U.S. Energy Research and Development Administration). US Patent 3,924,180. 2 Dec 1975. Filed date 12 Oct 1973. 6p.
PAT-APPL-406,053.

The disclosure relates to an apparatus and method for electrically analyzing biological cells. An orifice having two potential sensing electrodes is immersed in a container of saline solution in which cells to be analyzed are suspended. The entrance of the orifice communicates with the saline solution and the exit of the orifice communicates with a device for evacuating the cell containing saline solution through the orifice. Two potential sensing electrodes embedded in the orifice are connected to a high impedance differential amplifier which outputs to a pulse-height analyzer and a display or recording device. In operation, a source of current is applied to the orifice through external power electrodes to provide an electrical potential across the electrodes. Cells within the solution passing through the orifice vary the resistance between the electrodes and hence the potential difference between the electrodes. The high impedance differential amplifier amplifies this change in potential difference so that it can be received by the pulse height analyzer and recorded or displayed.

11403 Vibrating fiber electrometer. Spokas, J.J. (to U.S. Energy Research and Development Administration). US Patent 3,924,184. 2 Dec 1975. Filed date 16 Sep 1974. 8p.
PAT-APPL-506,478.

Improved operation of a vibrating fiber electrometer having a flexible conductive fiber positioned between two deflecting is achieved by maintaining the pressure of the atmosphere surrounding the fiber at a value where the ratio of the amplitude of vibration of the fiber at its resonance frequency to the amplitude of vibration at twice the resonance frequency is equal to or greater than 5 and having an alternating voltage of frequency equal to the natural frequency of the fiber applied to the deflecting electrodes. Automatic, continuous operation of the vibrating fiber electrometer is attained by projecting the image of the fiber onto a photosensitive detector which develops a signal corresponding to the phase of vibration of the fiber. A servo system coupled to the fiber and the deflecting electrodes and the detector is responsive to the signal to minimize automatically the vibration of the fiber.

11404 Intrusion detector self-test system. Schwarz, F. (to U.S. Energy Research and Development Administration). US Patent 3,928,849. 23 Dec 1975. Filed date 17 Dec 1974. 6p.
PAT-APPL-533,741.

An intrusion detection system is described which automatically makes periodic tests of the operability of the system and provides an alarm in the event of a malfunction during the supervisory self-check regimen which alarm is distinguishable from the normal intrusion alarm.

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

REFER ALSO TO CITATION(S) 11104, 11179, 11418

11405 (MHSMP—71-113) **Compressibility test study. Progress report, July—September 1971.** Johnson, H.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1971. 11p. Dep. NTIS $3.50.
For Lawrence Livermore Lab., CA.

RX-04-EA, RX-04-EB and RX-04-DW test specimens experienced a compression of approximately 2.48 mils in a 30-day period. LX-10-0, Lot 710-2 compressed 4.17 mils the first fifteen days.

11406 (MHSMP—73-18D) **Mechanical properties of high explosives. Progress report, January—March 1973.** Johnson, H.D.; Wilson, A.L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 19p. Dep. NTIS $3.50.
For Lawrence Livermore Lab., CA.

Mechanical properties test indicate that RX-04-EE is significantly stronger than both RX-04-EF and LX-10-0 Lot 710-4. The apparent high elasticity of the Estane materials was noted during the machining operations. The compressibility test specimens average decrease in length was 14.5 mils for the RX-04-EF and 12.8 mils for RX-04-EE after 30 days of confined thermal cycling.

11407 (MHSMP—76-2) **HNS crystallization studies. Progress report, October—December 1975.** Sandoval, J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1975. Contract DA-11-173-AMC-487. 13p. Dep. NTIS $3.50.
For Sandia Labs., Albuquerque, NM.

High purity HNS, on a laboratory scale, has been repeatedly recrystallized from a dual solvent system consisting of acetonitrile and dimethylformamide. The crystalline crop has been subjected to preliminary evaluation of specification requirements.

11408 **Tagging explosives with sulfur hexafluoride.** Dietz, R.N.; Cote, E.A.; Vogel, W. (to U.S. Energy Research and Development Administration). US Patent Application 577,822. Filed date 15 May 1975. 7p.

A method and apparatus are described for tagging explosives with a source of SF_6, permitting the detection of their presence using a sensitive sniffing apparatus.

11409 **Explosive device.** Dietzel, R.W.; Leslie, W.B. (to U.S. Energy Research and Development Administration). US Patent Application 555,754. Filed date 6 Mar 1975. 11p.

An explosive device is described which employs a particular titanium hydride-potassium perchlorate composition directly ignitible by an electrical bridgewire.

11410 **Fluorodinitroethyl difluoroformal and process of manufacture.** Peters, H.M.; Simon, R.L. Jr. (to U.S. Energy Research and Development Administration). US Patent 3,922,311. 25 Nov 1975. Filed date 10 May 1972. 8p.

PAT-APPL-251,878.

Bis(2-fluoro-2,2-dinitroethyl) difluoroformal (difluoro-FEFO) is prepared by reacting bis(2-fluoro-2,2-dinitroethyl) carbonate with SF_4 and HF and recovering the product. An alternative procedure for producing the compound as well as procedures for producing the starting materials are also disclosed. The compound is a highly energetic material especially suited for use in explosive compositions.

NUCLEAR

REFER ALSO TO CITATION(S) 10960, 11216, 11228, 11384

11411 (UCID—17018) **Flow through porous media from a nuclear cavity.** Morrison, F.A. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1975. Contract W-7405-Eng-48. 29p. Dep. NTIS $4.00.

The transport of fluid from the cavity formed by an underground nuclear explosion was investigated. Driven by the high cavity pressure, steam and noncondensing gas enter the surrounding porous medium. Their subsequent motion through the medium is described and the extent of penetration determined. The relations governing the transport are presented. An implicit iterative computational method is developed. The relative merits of this technique are discussed. The method is applied to a nuclear test. Results of calculations are presented and discussed. (auth)

11412 (UCRL—50028-75-2, pp 52-55) **Special projects group.** 1975.

In H-Division quarterly report, April—June 1975.

In the Special Projects Group, individuals or small groups work on new projects or special problems. The work is relatively short-term and does not logically fit into the other six H-Division groups. Activities reported on include studies on fracture mechanics, shallow earth penetration concept, and shock wave data compilation. (TFD)

11413 (UCRL—51975) **Medium properties and total energy coupling in underground explosions.** Kurtz, S.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Dec 1975. Contract W-7405-Eng-48. 46p. Dep. NTIS $4.00.

A phenomenological model is presented that allows the direct calculation of the effects of variations in medium properties on the total energy coupling between the medium and an underground explosion. The model presented is based upon the assumption that the shock wave generated in the medium can be described as a spherical blast wave at early times. The total energy coupled to the medium is then simply the sum of the kinetic and internal energies of this blast wave. Results obtained by use of this model indicate that the energy coupling is more strongly affected by the medium's porosity than by its water content. These results agree well with those obtained by summing the energy deposited by the blast wave as a function of range. (auth)

11414 **COMPARATIVE STUDY OF STRUCTURAL RESPONSE TO EXPLOSION-INDUCED GROUND MOTIONS.** New York; American Society of Civil Engineers (1975). 144p. (PNE-RB—74). $6.00.

Results of ground motion effects on mechanical structures in the vicinity of the Rio Blanco Event are presented. The structures observed included a 100 ft high truss-type microwave tower, a 70 ft vertical, cylindrical steel, refinery-type structure, a single-story wood frame residence, an 80 ft clear span, wood roof, reinforced-concrete column gymnasium, and an 80 ft high earth-fill dam. The investigation was done in the hope that the results obtained will provide further impetus for the incorporation of dynamic earthquake analysis requirements in building codes. (TFD)

11415 **Apparatus for reducing shock and overpressure.** Walter, C.E. (to U.S. Energy Research and Development Administration). US Patent 3,913,481. 21 Oct 1975. Filed date 17 Sep 1973. 6p.

PAT-APPL-398,262.

The design is given of an apparatus for reducing shock and overpressure particularly useful in connection with the sequential detonation of a series of nuclear explosives underground. A coupling and decoupling arrangement between adjacent nuclear explosives in the tubing string utilized to emplace the explosives is able to support lower elements on the string but yields in a manner which absorbs energy when subjected to the shock wave produced upon detonation of one of the explosives. Overpressure is accommodated by an arrangement in the string which provides an additional space into which the pressurized material can expand at a predetermined overpressure.

11416 **System for remote control of underground device.** Brumleve, T.D.; Hicks, M.G.; Jones, M.O. (to U.S. Energy Research and Development Administration). US Patent 3,914,732. 21 Oct 1975. Filed date 23 Jul 1973. 8p.

PAT-APPL-381,632.

A system is described for remote control of an underground device, particularly a nuclear explosive. The system includes means at the surface of the ground for transmitting a seismic signal sequence through the earth having controlled and predetermined signal characteristics for initiating a selected action in the device. Additional apparatus, located with or adjacent to the underground device, produces electrical signals in response to the seismic signals received and compares these electrical signals with the predetermined signal characteristics.

11417 **Analysis of seismic response in the city of Las Vegas, Nevada: a preliminary microzonation.** Murphy, J.R.; Hewlett, R.A. *Bull. Seismol. Soc. Am.*; **65**: No. 6, 1575-1597(Dec 1975).

Ground motion data recorded at 26 different locations in Las Vegas from six underground nuclear tests have been used to perform a preliminary microzonation of the city. The microzonation results are presented in the form of contour maps of the average observed seismic response throughout the city in 12 different frequency bands covering the period range from 0.16 to 6.0 sec. These data indicate that variations in long-period seismic response of as much as an order of magnitude can be expected at sites only a few kilometers apart in the city. Simple models of surface-wave propagation in the surface layer of alluvium of variable thickness can account for much of the observed variability. However, it appears that surface waves reflected back from the valley boundaries at the base of the surrounding mountain ranges also have a significant effect on the measured response. (auth)

CIVIL USES

REFER ALSO TO CITATION(S) 11104, 11151, 11469

11418 (AD/A—005001) **Ground motion and airblast measurements on shot 6M of Diamond Ore. Final report.** Vincent, C.T. (Physics International Co., San Leandro, Calif. (USA)). Dec 1974. Contract DACA07-72-C-0036. 58p. (PIFR—436). NTIS $4.25.

On Diamond Ore shot 6M, a 17-ton charge of nitromethane located at a depth of 5.85 meters (19.2 ft) in Bear Paw clay shale, Physics International Company measured (1) shock velocity up the unstemmed hole from charge surface to the ground surface, (2) stress at three locations along two radial lines 90 degrees apart, (3) horizontal and vertical particle velocity at one location along each radial line, and (4) airblast overpressures at the ground surface. Shock velocity up the unstemmed hole was twice the predicted value. Peak stresses were lower than predictions. Difficulties were encountered in measuring particle velocity because accelerations were higher than expected. Surface-level peak overpressures were greater than predicted for a buried TNT charge and less than the Sprint in-cell measurements. (GRA)

11419 (AD-A—009216) **PNE (peaceful nuclear explosion) activity projections for arms control planning. Volume I.** (Gulf Universities Research Consortium, Galveston, Tex. (USA)). 10 Apr 1975. Contract ACDA/PAB-253. 219p. NTIS $3.25.

See also Volume II, AD-A—009217.

The report projects the use of contained Peaceful Nuclear Explosion (PNE) technology up to 1990. In doing so, specific applications are identified and analyzed; critical factors affecting amount, rate and probability of use in the 1980's are discussed;

delay times are analyzed; and conclusions which follow from the analysis are stated. The background discussion (Section 1) contains a brief historical discussion and chronology; and describes the advantages and disadvantages in general of PNE technology. The analysis methodology falls into four parts: technology, costs, regulatory problems, and economics (Section 2). Selected applications are examined in detail (Section 3). Criteria are stated for selection, with a list of 15 proposed applications. Five applications were selected for micro-analysis. (GRA)

11420 (AD-A—009217) **PNE (peaceful nuclear explosion) activity projections for arms control planning. Volume II. Appendices.** (Gulf Universities Research Consortium, Galveston, Tex. (USA)). Apr 1975. Contract ACDA/PAB-253. 273p. NTIS $8.50.

See also Volume I, AD-A—009216.

Topics discussed include oil shale; tight gas; storage; copper; oil stimulation; industry workshop on PNE applications; and projections of PNE use. (GRA)

11421 (PNE-RB—75) **Project Rio Blanco: alternate reentry well RB-AR-2 hole history.** (Fenix and Scisson, Inc., Las Vegas, Nev. (USA)). Feb 1976. Contract E(26-1)-38. 50p. Dep. NTIS $5.50.

An account of the drilling operations for well RB-AR-2 which entered the middle chimney of the three-shot Rio Blanco Project is presented. (TFD)

11422 (SAND—75-0486) **Comparison of predicted and observed pore pressure increases on Rio Blanco.** Banister, J.R.; Ellett, D.M.; Pyke, R.; Winters, L. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 84p. Dep. NTIS $6.00.

The RIO BLANCO event presented the opportunity to monitor, under controlled conditions in the field, the increase in pore pressures resulting from ground motion similar to an earthquake. In situ measurements of pore pressure changes were made by Sandia Laboratories and Dames and Moore. This report contains the results of laboratory tests believed to be indicative in assessing the magnitude of pore pressure increases and probability of soil liquefaction. These include triaxial load tests, gradation of grain size, and relative density. No liquefaction was observed in the field, and the increase of in situ pore pressures were much less than expected from laboratory measurements. Allied subjects presented in this report are pore pressure propagation and dissipation profiles, the previously unpublished pore pressure measurements made by Dames and Moore, and the boring logs for the various sites where measurements were taken. It is concluded that methods used to predict pore pressure increases and liquefaction potential are overly conservative, at least for these alluvial and colluvial soils found in Colorado. (auth)

11423 **Method and apparatus for generating steam by nuclear explosion with suppressed radiation and blast effects.** Rosciszewski, J.J. US Patent 3,921,405. 25 Nov 1975. Filed date 19 Dec 1973. 6p.

The generating of steam by exploding a thermonuclear bomb in an expansion chamber in a breakable container filled with working fluid or solid that is placed in the expansion chamber that is then evacuated, and after initiating the thermonuclear explosion, utilizing the energy released to directly evaporate the enclosing working fluid or solid and expanding it in the much larger chamber volume to pressure and temperatures suitable for a power generation. (auth)

WEAPONRY

REFER ALSO TO CITATION(S) 11248, 11466

11424 (AD/A—004942) **Prediction techniques for refraction of underwater explosion shock waves: a shipboard computer program.** Goertner, J.A. (Naval Ordnance Lab., White Oak, Md. (USA)). 4 Dec 1974. 74p. (NOLTR—74-157). NTIS $4.25.

Because of the spatial and temporal variation of refractive conditions in the ocean, a capability is required for making onboard predictions of refractive effects on safe delivery ranges for submarine-launched nuclear weapons. The computer program (CARE) described indicates the feasibility of such a shipboard prediction capability. The program can be converted for use on any multipurpose computer having a storage capacity of about 16K, which is well within the specifications for currently used Navy computers. (GRA)

11425 (SAND—75-0426, pp 4-7) **Electric contact arcing.** Cuthrell, R.E. Feb 1976.

In Sandia technology, Autumn 1975.

Electrical contacts must function properly in many types of components used in nuclear weapon systems. Design, application, and testing of these components require detailed knowledge of chemical and physical phenomena associated with stockpile storage, stockpile testing, and operation. In the past, investigation of these phenomena has led to significant discoveries on the effects of surface contaminants, friction and wear, and the mechanics of closure on contact performance. A recent investigation of contact arcing phenomena which revealed that, preceding contact closure, arcs may occur at voltages lower than had been previously known is described. This discovery is important, since arcing may damage contacts, and repetitive testing of contacts performed as part of a quality assurance program might produce cumulative damage that would yield misleading life-test data and could prevent proper operation of the contacts at some time in the future. This damage can be avoided by determining the conditions under which arcing occurs, and ensuring that these conditions are avoided in contact testing.

11426 (UCRL—51981) **Tactical nuclear studies: a more comprehensive approach.** Blumenthal, D.; Kooshian, C.; Reinhardt, G.; Staehle, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Dec 1975. Contract W-7405-Eng-48. 12p. Dep. NTIS $3.50.

A matrix scheme for evaluating complex tactical nuclear systems is proposed. Advantages resulting from consideration of system characteristics in peace and crisis as well as war include avoidance of scenario-dependent conclusions, ease of maintaining awareness of relationships between immediate concerns and the complex whole, and highlighting of areas or concerns that have been overlooked or neglected. (auth)

EXPLOSION DETECTION

REFER ALSO TO CITATION(S) 11348

11427 (AD/A—004991) **The effects of reduced configurations at (LASA) on detection signal-to-noise ratios. Technical report.** Chiburis, E.F.; Ahner, R.O.; Chang, A.C.; Kerr, A.U. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 3 May 1974. Contract F08606-74-C-0006. 37p. (SDAC-TR—74-7). NTIS $3.75.

The effects of varying the configuration of the Large Aperture Seismic Array (LASA) on the detection signal-to-noise ratio observed in the Seismic Data Analysis Center Detection Processor are discussed. It is shown that a configuration for the LASA of thirteen subarrays (A, B, C, and D rings) with 16 sensors per subarray produces an average loss of 0.2 + - 0.3 db (one standard deviation of the mean) from the current configuration of seventeen subarrays (A, B, C, D, and E rings) using sixteen sensors per subarray. Reducing the number of subarrays to nine (A, B, and C rings) with only 7 elements per subarray produces an average loss of 3.5 +- 0.3 db. These results are in general agreement with known results on variation of noise reduction and signal loss as a function of subarray and subarray sensor selection. (GRA)

11428 (AD/A—006194) **Seismic discrimination. Semiannual technical summary report, 1 Jul-31 Dec 1974.** Chinnery, M.A. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 31 Dec 1974. Contract F19628-73-C-0002. 62p. NTIS $4.25.

See also report No. AD—785377.

This report describes 22 separate investigations in the field of seismic discrimination. These are grouped as follows: discrimination and evasion research (5 contributions); method for the determination of focal depth (4 contributions); global seismic network studies (4 contributions); studies of earth heterogeneity (4 contributions); source mechanism studies (3 contributions); and investigations of global seismic activity (2 contributions). (GRA)

11429 (AD/A—007043) **Study of two automatic short-period signal detectors. Technical report No. 9. Vela network evaluation and automatic processing research.** Lane, S.S. (Texas Instruments, Inc., Dallas (USA)). 6 Dec 1974. Contract F08606-74-C-0033. 32p. (TI-ALEX—(01)-TR-74-09). NTIS $3.75.

See also report dated 15 Nov 1974, AD/A—003676.

The Fisher detector and conventional power detector have been implemented on short-period data recorded at the Korean Seismic Research Station. It was found that false alarm rates varied so widely from day to day that no comparison between detectors could be made. However, a comparison between detectors with different integration times but the same false alarm rate revealed that integration time does not affect the probability of detection. (GRA)

11430 (AD/A—007044) **Earth noise at very long period experiment stations. Technical report No. 3. Vela network evaluation and automatic processing research.** Prahl, S.R. (Texas Instruments,

Inc., Dallas (USA)). 27 Nov 1974. Contract F08606-74-C-0033. 77p. (TIsALEX—(01)-TR-74-03). NTIS $4.75.

The report presents the results of a study of the noise characteristics of eleven Very Long Period Experiment (VLPE) stations. For the period from January 1972 through March 1973, 1503 one-hour vertical component and 846 one-hour three-component noise samples were processed and analyzed for short-and long-term vertical component noise trends, three-component spectra, and two-component coherence spectra. (GRA)

11431 (AD/A—008280) **An interactive system for long-period seismic processing. Technical report No. 11. Vela network evaluation and automatic processing research.** Ringdal, F.; Shaub, J.S. (Texas Instruments, Inc., Dallas (USA)). 10 Dec 1974. Contract F08606-74-C-0033. 56p. (TI-ALEX—(01)-TR-74-11). NTIS $4.25.

See also report dated 6 Dec 1974, AD/A—007043.

The report describes an interactive graphics processing system developed for the PDP-15 computer at the Seismic Data Analysis Center. The system is designed to process long-period seismic data and includes options for interactive bandpass filtering, matched filtering, spectral analysis and parameter measurements. The main intention of the program development has been to investigate the feasibility of using interactive graphics for event detection purposes in a potential world-wide seismic surveillance system. An evaluation of the expected operational capabilities of the system has been carried out, using data recorded by the Very Long-Period Experiment network as a source. Conclusions from this evaluation and recommendations for future study are presented. (GRA)

11432 (CONF-760307—1) **Measurement and evaluation of high-rise building response to ground motion generated by underground nuclear explosions.** Honda, K.K. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). 1976. 11p. Dep. NTIS $3.50.

From ASCE;EMD specialty conference on dynamic response of structures; Los Angeles, California, United States of America "USA" (30 Mar 1976).

As part of the structural response research program being conducted for ERDA, the response behavior of high-rise buildings in Las Vegas, Nevada, due to ground motion caused by underground nuclear explosions (UNEs) at the Nevada Test Site (NTS) has been measured for the past 12 years. Results obtained include variation in dynamic response properties as a function of amplitude of motion, influence of nonstructural partitions in the building response, and comparison of calculated and measured response. These data for three reinforced concrete high-rise buildings, all designed as moment-resisting space frames are presented. (auth)

11433 (CONF-760307—2) **Testing wall panels for earthquake response.** Freeman, S.A. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). 1976. 11p. Dep. NTIS $3.50.

From ASCE;EMD specialty conference on dynamic response of structures; Los Angeles, California, United States of America "USA" (30 Mar 1976).

As part of the structural response research program being conducted for the Nevada Operations Office of ERDA a testing program for the investigation of nonstructural wall panels subjected to racking was developed and conducted. The objectives of the testing program were to determine thresholds for damage to partitions due to horizontal adjacent story displacement in high-rise buildings and to gather data that can be used to determine the influence of nonstructural partitions on the structural response of high-rise buildings. In general, the wall panels were constructed to represent typical partitions used in high-rise building construction. Some of the panels were used for special parameter studies or for comparisons with other test programs. A specially designed testing frame simulated cyclic lateral displacement, parallel to the plane of the wall panels, that might be experienced during the response of a building to strong winds or earthquake motion. Stiffness and strength characteristics, estimates of equivalent viscous damping, and damage threshold results were obtained. The data appear to give a good approximate evaluation of the performance of non-load-bearing partitions under cyclic loading. (LCL)

11434 (CONF-760307—3) **Dynamic response characteristics of reinforced concrete structures.** Freeman, S.A.; Chen, C.K.; Czarnecki, R.M. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). 1976. 11p. Dep. NTIS $3.50.

From ASCE;EMD specialty conference on dynamic response of structures; Los Angeles, California, United States of America "USA" (30 Mar 1976).

A program of vibration investigations of two identical 4-story reinforced concrete test structures which were constructed in 1965 at the Nevada Test Site is summarized. These investigations were conducted as part of a structural response program associated with the detonation of underground nuclear explosions. The structures were built to obtain experimental data on the dynamic response characteristics of high-rise concrete buildings, ultimately leading to the development of improved techniques for predicting damage and response to ground motion. Information is included on the four-story test structure, test equipment and methods, methods of response data analysis, and comparison of calculated and measured dynamic response of reinforced concrete structure. The results showed that conventional modelling techniques could be used to accurately predict response in the elastic range. (LCL)

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

REFER ALSO TO CITATION(S) 10842, 11136

11435 (CONF-740701—) **Proceedings of the second international conference on nuclear methods in environmental research, University of Missouri, Columbia, July 29, 30, and 31, 1974.** Vogt, J.R.; Meyer, W. (eds.). (Missouri Univ., Columbia (USA). Coll. of Engineering). Jul 1974. Contract AT(49-7)-3140. 479p. Dep. NTIS $10.60.

From 2. international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

Separate abstracts were entered for the 43 items in the conference. Twenty-eight were included in Nuclear Science Abstracts, and all were included in ERDA Energy Research Abstracts. (SFL)

11436 (TID—26941) **Bibliography of reports by U.S. Geological Survey personnel on the Nevada Test Site and related subjects, July 1, 1974 to June 30, 1975, with author and subject indexes.** Ohl, J.P. (Geological Survey, Denver, Colo. (USA)). 1975. Contract AT(29-2)-474. 35p. Dep. NTIS $4.00.

The bibliography includes reports issued between July 1, 1974, and June 30, 1975, by personnel of the U. S. Geological Survey on the Nevada Test Site and related subjects and areas. A special feature of this bibliography is a partial list of USGS-474 series reports (USGS-474-153 through USGS-474-221) showing those reports in the series that have been issued since the last bibliography or their present status if still in preparation. Cross references to show the alternative designation of these reports in the various administrative series are listed. Reports numbered in the USGS-474 series are usually made available to the public through NTIS (U. S. Department of Commerce, National Technical Information Service, Springfield, VA 22161), and may be purchased at $2.25 per microfiche copy; hard copies of the reports released since March 10, 1973, are prices at $4.00 for 1-50 pages, $5.45 for 51-150 pages, $7.60 for 151-325 pages. An index map shows the area of the Nevada Test Site as it is divided into $7^1/_2$-minute quadrangels; a second map of the Nevada Test Site shows how it is divded into numbered areas. The area of the Central Nevada Test Area, divided into 15-minute quadrangels, is shown and the locations of sites B, C, D, E, and F on Amchitka Island Supplemental Test Site are shown. (auth)

BASIC STUDIES

REFER ALSO TO CITATION(S) 10822, 10839

11437 (AD/A—007872) **An indirect method for measuring surface-based temperature inversions. Memorandum report.** Stamulis, A. (Naval Research Lab., Washington, D.C. (USA)). Mar 1974. 19p. (NRL-MR—2748). NTIS $3.25.

An indirect method for determining and measuring surface-based temperature inversions is proposed. The instrumentation for this purpose is a constant air monitor that measures the natural radioactivity of the atmosphere and records it on a strip chart. By means of deflections in the normal background radioactivity, the beginning and end of the inversion, as well as the time of maximum deflection, can be determined. In addition, a prolonged deflection continuing into the afternoon indicates that an air episode or smog alert may be forecast. Comparison of this method with that used by the National Weather Service Forecast Office gives reasonable agreement. Differences are probably due to local climatic differences, topography, and to inclusion of data for Saturdays, Sundays, and holidays. (GRA)

11438 (BNL—20701) **ERDA/National Laboratories workshop on environmental effects of energy held at Rockefeller University, New York, New York, September 4—5, 1975.** (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. Contract E(30-1)-16. 141p. Dep. NTIS $7.00.

The important environmental impacts of energy production are summarized. A summary of these impacts associated with each step of the nuclear fuel cycle is included. (CH)

11439 (BNWL—1964) **Resuspension of material dispersed by atmospheric diffusion from a point source.** Horst, T.W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1975. Contract E(45-1)-1830. 55p. Dep. NTIS $5.50.

One year of hourly data from the Hanford Meteorological Tower has been selected to represent a typical climatological distribution of the meteorological variables which control atmospheric diffusion, deposition, and resuspension. This data was used in a surface flux model to predict the probable value of both the initial air concentration, accounting for the depletion due to deposition, and the consequent air concentration of resuspended material whose source is the material deposited on the ground by the initial plume. (auth)

11440 **Formation of pollution particulate nitrogen compounds by NO-soot and NH_3-soot gas-particle surface reactions.** Chang, S.G.; Novakov, T. (Univ. of California, Berkeley). *Atmos. Environ.*; 9; No. 5, 495-504(1975).

Three reduced forms of nitrogen are associated with ambient air pollution particulates: ammonium and two additional species assigned to amine and/or amide and to nitrile. Nitrogen species of the same type and behavior can be synthesized in soot (or graphite) interactions with NO or NH_3. Volatile hydroxyl and carboxyl ammonium salts (and/or physically adsorbed ammonia species) are produced in soot—NO and soot—NH_3 reactions at ambient temperatures, while amines, amides and nitriles are produced at higher temperatures. The proposed mechanism is in qualitative agreement with the field observations. The experiments were performed with the aid of X-ray photoelectron spectroscopy, ESCA. (auth)

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 11125

11441 (BNWL-SA—5421) **Computer system for environmental sample analysis and data storage and analysis.** Brauer, F.P.; Fager, J.E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 15 Sep 1975. Contract E(45-1)-1830. 24p. (CONF-751116—27). Dep. NTIS $4.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

A mini-computer based environmental sample analysis and data storage system has been developed. The system is used for analytical data acquisition, computation, storage of analytical results, and tabulation of selected or derived results for data analysis, interpretation and reporting. This paper discusses the structure, performance and applications of the system. (auth)

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 10247, 10248, 10272, 10449, 10781, 11126, 11458

11442 (AD-A—009868) **Economically optimal design of particulate air pollutant control equipment.** Stone, C.W. (Aeronautical Systems Div., Wright-Patterson AFB, Ohio (USA)). Jan 1975. 154p. (ASD/XR-TR—75-2). NTIS $6.25.

Thesis.

An analytical study of the economically optimal design of particulate air pollutant control equipment is presented. Two major control equipment types, electrostatic precipitators and cyclones, are modeled and optimized with respect to total system economics. The equipment models are defined as a combination of functional elements. Basic mathematical definitions of particle distribution functions, particle collection efficiency, gas flow parameters and gas ionization are employed in the derivation of the various functional elements. The electrostatic precipitator model is developed and optimized using three functional elements. These elements are defined as electrical power requirements, gas flow/pressure drop and the economic considerations of precipitation. The electrostatic precipitator model resulting from the integration of the three functional elements is of such a degree of complexity when examined as a whole that it is more practical to optimize the individual elements. The tangential inlet cyclone model is developed and optimized using two functional elements. These elements are defined as power requirements and cyclone economics. Empirical equations defining the particle collection efficiency and pressure drop of a cyclone system are employed in the formulation of the power requirements model. (GRA)

11443 (DPSPU—75-30-11) **Computer handling of Savannah River Plant environmental monitoring data.** Zeigler, C.C. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Plant). Dec 1975. Contract AT(07-2)-1. 11p. (CONF-760202—28). Dep. NTIS $3.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

At the Savannah River Plant, computer programs are used to calculate, store, and retrieve radioactive and nonradioactive environmental monitoring data. Objectives are to provide daily, monthly, and annual summaries of all routine monitoring data; to calculate and tabulate releases according to radioisotopic species or nonradioactive pollutant, source point, and mode of entry to the environment (atmosphere, stream, or earthen seepage basins). The computer programs use a compatible numeric coding system for the data, and printouts are in the form required for internal and external reports. Data input and program maintenance are accomplished with punched cards, paper or magnetic tapes, and when applicable, with computer terminals. Additional aids for data evaluation provided by the programs are statistical counting errors, maximum and minimum values, standard deviations of averages, and other statistical analyses. (auth)

11444 (EUR—5290e) **Air quality management system for an industrialized region.** Mueller, K.H. (Commission of the European Communities, Brussels (Belgium)). 1975. 21p. Dep. NTIS (US Sales Only) $3.50. EUR FB 100,-.

The air pollution control strategy for an industrialized region can be based upon a set of air quality prediction tables, calculated by a correlation of historical meteorology and air quality data. They give a forecast of short-range pollution level which can be used as a warning system, transmission tables, established either by a mathematical or physical simulation of the dispersion process. When unfavourable pollution levels are predicted a reduction strategy has to be applied, which consists in (1) picking out all single emitters contributing to the pollution levels at the control points, (2) calculating reduction coefficients for the emitters which prevent the imminent pollution excess, and (3) selecting the most economic reduction from amongst the reducible source combinations. (auth)

11445 (LA—6103) **Monte Carlo simulation of the turbulent transport of airborne contaminants.** Watson, C.W.; Barr, S. (Los Alamos Scientific Lab., N.Mex. (USA)). Sep 1975. Contract W-7405-Eng-36. 28p. Dep. NTIS $4.00.

A generalized, three-dimensional Monte Carlo model and computer code (SPOOR) are described for simulating atmospheric transport and dispersal of small pollutant clouds. A cloud is represented by a large number of particles that we track by statistically sampling simulated wind and turbulence fields. These fields are based on generalized wind data for large-scale flow and turbulent energy spectra for the micro- and mesoscales. The large-scale field can be input from a climatological data base, or by means of real-time analyses, or from a separate, subjectively defined data base. We introduce the micro- and mesoscale wind fluctuations through a power spectral density, to include effects from a broad spectrum of turbulent-energy scales. The role of turbulence is simulated in both meander and dispersal. Complex flow fields and time-dependent diffusion rates are accounted for naturally, and shear effects are simulated automatically in the ensemble of particle trajectories. An important adjunct has been the development of computer-graphics displays. These include two- and three-dimensional (perspective) snapshots and color motion pictures of particle ensembles, plus running displays of differential and integral cloud characteristics. The model's versatility makes it a valuable atmospheric research tool that we can adapt easily into broader, multicomponent systems-analysis codes. Removal, transformation, dry or wet deposition, and resuspension of contaminant particles can be readily included. (auth)

11446 (LBL—4416) **Combustion-generated indoor air pollution. I. Field measurements 8/75—10/75.** Hollowell, C.D.; Budnitz, R.J.; Case, G.D.; Traynor, G.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1976. Contract W-7405-eng-48. 25p. Dep. NTIS $3.50.

The indoor air quality of six homes with gas and electric cooking and gas heating appliances was characterized to determine the level of gaseous and aerosol air pollutants from typical indoor combustion sources. Field measurements of SO_2, NO/NO_2, O_3, and CO were determined on a continuous basis. Total aerosol samples were collected on filter media for laboratory analysis by X-ray

fluorescence and ESCA techniques for the determination of aerosol elemental composition and ionic species such as SO_4^{2-}, NO_3^-, and NH_4^+. Results of the study indicate that levels of gaseous and respirable aerosol air pollutants in the indoor environment do frequently exceed those levels commonly found in the outdoor urban air. Such findings may have a large impact on the future design of epidemiological studies, on energy conservation strategies for buildings, and on the need for more stringent control of air pollution from indoor combustion sources. (auth)

11447 (PB—238095) **Measurement of sulfur dioxide, particulate, and trace elements in copper smelter converter and roaster/reverberatory gas streams. Environmental protection technology series, June 1973—April 1974 (final).** Statnick, R.M. (National Environmental Research Center, Research Triangle Park, N.C. (USA)). Oct 1974. 93p. (EPA—650/2-74-111). NTIS $4.75.

The report gives the results of the analysis of data on particulate, sulfur dioxide (SO_2), and trace element emissions and control efficiencies for a copper smelter. The SO_2 emission rates from the roaster/reverberatory and converter effluent streams were 518 and 587 lb/min, respectively. The acid plant's SO_2 control efficiency was 96.8 percent. The mass collection efficiency of the converter's electrostatic precipitator (ESP) for dry filterable solids was 95 percent. Analyzing emitted particulate gave the following mass emission rates (in lb/hr) for selected elements; arsenic (58.05), lead (24.65), cadmium (1.32), zinc (15.7), chromium (0.065), and copper (4.825). Control efficiency for the analyzed elements was between 90 and 98 percent. (GRA)

11448 (PB—238920) **Field testing: application of combustion modifications to control pollutant emissions from industrial boilers. Phase I. Final report, June 1973—July 1974, on phase 1.** Cato, G.A.; Buening, H.J.; DeVivo, C.C.; Morron, B.G.; Robinson, J.M. (KVB Engineering, Inc., Tustin, Calif. (USA)). Oct 1974. Contract EPA-68-02-1074. 213p. (SN—6000-28). NTIS $7.25.

The report gives results of field measurements made on 47 representative industrial boilers (75 boiler/fuel combinations) of 10,000-500,000 lb/hr of steam capacity throughout the Continental U.S. Pollutants measured were total nitrogen oxides (NO/sub x/), total particulates, total sulfur oxides, CO_2, CO, and hydrocarbon. Measurements were made of emissions from coal, oil, and natural gas fuels and a variety of coal stoker and oil atomization methods. The effectiveness of reduced excess air, reduced load, air register readjustment, and off-stoichiometric firing in reducing NO/sub x/ emissions is evaluated. The report covers the selection of the test boilers and discusses the emission requirements during the first phase of the program. The second phase will include results of more detailed long-term testing of representative current boilers. (GRA)

11449 (PB—240484) **Monitoring and air quality trends report, 1973.** (Environmental Protection Agency, Research Triangle Park, N.C. (USA). Office of Air Quality Planning and Standards). Oct 1974. 327p. (EPA—450/1-74-007). NTIS $9.50.

See also report dated Dec 1973, PB—234445.

The report presents a comprehensive tabulation of the nation's air quality and monitoring activities for 1973. These summaries are based on data acquired through extensive monitoring activities conducted by Federal, state, and local air pollution control agencies, and compiled according to the nation's 247 Air Quality Control Regions. Information is provided for the five pollutants for which National Ambient Air Quality Standards have been set (suspended particulate matter, sulfur dioxide, carbon monoxide, oxidants, and nitrogen dioxide). Analyses of pollutant trends are presented, plus a study of nonurban ozone concentrations and a preliminary examination of instances reflecting the energy crisis. (GRA)

11450 (PB—240615) **Environmental exposure system for studying air pollution damage to materials. Final report.** Spence, J.W.; Stump, F.D.; Haynie, F.H.; Upham, J.B. (National Environmental Research Center, Research Triangle Park, N.C. (USA)). Jan 1975. 46p. (EPA—650/3-75-001). NTIS $3.75.

Design features of a controlled-environment exposure system consisting of five chambers are described. The purpose of the environmental system is to provide simulated environments for conducting statistical experiments for determining pollutant damage to materials. Design features include independent controls for regulating temperature, relative humidity, and concentration of gaseous sulfur dioxide, nitrogen dioxide, and ozone. To achieve accelerated weathering, the system also includes a variable dew/light cycle that incorporates chill racks to produce dew and xenon lamps to simulate sunlight. Before initiating exposure studies, differences in lighting and pollutant distribution among the chambers were minimized to below 10 percent variations for 95 percent of the measurements. (GRA)

11451 (PB—240997) **Air pollution considerations in residential planning. Volume I. Manual. Final report.** Briggs, T.M.; Overstreet, M.; Kothari, A.; Devitt, T.W. (PEDCO-Environmental Specialists, Inc., Cincinnati, Ohio (USA)). Jul 1974. Contract EPA-68-02-1089. 174p. NTIS $6.25.

Prepared in cooperation with Department of Housing and Urban Development, Washington, D.C. See also PB—240998.

A practical procedure is presented for use by HUD staff and housing planners and designers in determining the air pollution exposure of residential developments. Methods are presented to determine the short-term worst-case concentrations at specific site locations of carbon monoxide from roadways and parking lots and particulate and sulfur dioxide from point sources and space heating. Procedures are also presented for convert total outdoor pollutant concentrations to indoor levels as a function of building structural characteristics. Outdoor and indoor pollutant levels are compared to air quality standards to determine site acceptability. Recommended design practices are also presented to aid the planner in minimizing the impact of air pollution on residents of the development. (GRA)

11452 (PB—240998) **Air pollution considerations in residential planning. Volume II. Backup report. Final report.** Briggs, T.M.; Overstreet, M.; Kothari, A.; Devitt, T.W. (PEDCO-Environmental Specialists, Inc., Cincinnati, Ohio (USA)). Jul 1974. Contract EPA-68-02-1089. 105p. NTIS $5.25.

Prepared in cooperation with Department of Housing and Urban Development, Washington, D.C. See also PB—240997.

The backup report presents the technical basis for the air quality estimation procedures presented in the manual. Included are the justification for selecting only particulates, SO_2 and CO for study, and the basis of the air quality criteria levels. A detailed description of the method for converting outdoor pollutant levels to indoor concentrations is also presented. Limitations of the manual's procedures are presented together with recommendations for future research. (GRA)

11453 **Surface predominance of trace elements in airborne particles.** Linton, R.W.; Loh, A.; Natusch, D.F.S.; Evans, C.A. Jr.; Williams, P. (Univ. of Illinois, Urbana). *Science;* **191**: No. 4229, 852-854(1975).

A number of minor and trace elements including Be, C, Ca, Cr, K, Li, Mn, Na, P, Pb, S, Tl, V, and Zn present in coal fly ash are found to be preferentially concentrated on the particle surfaces. Environmentally effective concentrations of these elements are thus much higher than indicated by conventional bulk analyses. (auth)

11454 **Remote detection of pollutants using resonance Raman scattering.** Rosen, H.; Robrish, P.; Chamberlain, O. (Univ. of California, Berkeley). *Appl. Opt.;* **14**: No. 11, 2703-2706(Nov 1975).

Calculations of the resonance Raman cross section for several diatomic molecules are presented. These results are used, together with recent measurements of large resonance enhancements in NO_2 and SO_2, to estimate the sensitivity of a lidar system based upon the resonance Raman effect. (auth)

11455 **System for detecting gaseous contaminants in air.** Gentry, W.O. (to U.S. Energy Research and Development Administration). US Patent 3,926,560. 16 Dec 1975. Filed date 30 Oct 1973. 6p.

PAT-APPL-411,128.

A system for detecting the presence in air of selected gaseous contaminants is described. The system includes an aerosol detector arranged to monitor the air including a first electrode and a second perforate electrode defining a chamber within which said first electrode is disposed and which is open to ambient atmosphere; a radioactive source for dissociating air molecules within said chamber; and a vapor emitter for introducing to the air a vapor selected to form an aerosol by chemical reaction with said gaseous contaminants.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 10451, 10653, 11443, 11469, 11657

11456 (ANL—75-60(Pt.2), pp 146-148) **Use of a microprocessor in a remote working level monitor.** Keffe, D.J.; McDowell, W.P.; Groer, P.G. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

A remote working level monitor was designed to measure short-lived radon-daughter concentrations in sealed chambers having potentially high radiation levels (up to 2000 WL). The system is comprised of surface barrier detectors, multiplexer and buffers, microprocessor and teletype. (SFL)

11457 (BNWL-SA—5541) **Cleanup of radon inhalation study effluents.** Anderson, B.V.; Palmer, R.F. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1976. Contract E(45-1)-1830. 6p. (CONF-760202—27). Dep. NTIS $3.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Studies of the effects of inhalation in animals of radon and its daughter products, in progress in the Battelle-Northwest laboratory for several years, have resulted in continuous release to the environment of approximately 300 μCi of ^{222}Rn per minute. A recent change in the physical location of these studies to a less isolated area required development of a radon retention system capable of decontaminating 4,000 cubic meters of moist, radon-bearing air per month. Experimental data are reported on radon retention by activated carbon. The data collected were used to design a system for retention of 99 percent of the radon leaving an inhalation exposure chamber. A flow diagram, shielding considerations for the carbon beds, and operating characteristics of the proposed system are presented. A successful test of the prototype retention system indicated that 40 cubic meters of air would be decontaminated of radon by one kilogram of PCB (6 x 10 mesh) activated carbon under experimental conditions of 0 +- 2°C and 330 cm/min superficial velocity or 660 cm/min true velocity with 50 percent void. (auth)

11458 (CONF-7405106—) **Proceedings of the symposium on power generation and air quality, May 9—10, 1974, Raleigh, North Carolina.** (North Carolina State Univ., Raleigh (USA)). 1974. 119p. Univ. of North Carolina, Chapel Hill, NC.

From Symposium on power generation and air quality; Raleigh, North Carolina, USA (9 May 1974).

Papers and discussions on air quality and electric power generation are presented. Primary attention is on the nature and effects of pollutants entering the atmosphere from central station power plants. Topic areas include energy needs and source emissions, source emissions and environmental considerations, health effects, ecological effects, control technology and costs, and alternatives and prospects. (auth)

11459 (UCRL—77572) **ARAC system.** Kelly, M.F.; Wyman, R.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Dec 1975. 5p. (CONF-760105—1). Dep. NTIS $3.50.

From 9. Hawaii international conference on system sciences; Honolulu, Hawaii, United States of America ^{8}USA^{9} (6 Jan 1976).

In spite of the remarkable safety record of the nuclear industry as a whole, recent public concern over the potential impact of the industry's accelerated growth has prompted ERDA to expand its emergency response procedures. The Atmospheric Release Advisory Capability, ARAC, is a computer communications system designed to enhance the existing emergency response capability of ERDA nuclear facilities. ARAC will add at least two new functions to this capability: centralized, real-time data acquisition and storage, and simulation of the long range atmospheric transport of hazardous materials. To perform these functions, ARAC employs four major sub-systems or facilities: the site facility, the central facility, the global weather center and the regional model. The system has been under development for the past two years at the Lawrence Livermore Laboratory of the University of California. (auth)

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 11471

REGULATIONS

REFER ALSO TO CITATION(S) 10323, 10832, 12320

ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 10842, 10906, 11136, 11436

BASIC STUDIES

REFER ALSO TO CITATION(S) 10839, 11438

11460 (BNWL-SA—5567) **Sampling big sagebrush for phytomass.** Uresk, D.W.; Gilbert, R.O.; Rickard, W.H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 18p. (CONF-751169—1). Dep. NTIS $3.50.

From Workshop on wildland shrub; Provo, Utah, United States of America ^{8}USA^{9} (4 Nov 1975).

Big sagebrush (Artemisia tridentata) was subjected to a double sampling procedure to obtain reliable phytomass estimates for leaves, flowering stalks, live wood, dead wood, various combinations of the preceeding, and total phytomass. Coefficients of determination (R^2) between the independent variable and various phytomass categories ranged from 0.45 to 0.93. Total phytomass was approximately 69 +- 16 (+- S.E.) g/m^2. Reductions in the variance of the phytomass estimates ranged from 33 percent to 80 percent using double sampling assuming optimum allocation. (auth)

11461 (ORNL-tr—4031) **Findings from newly discovered prehistoric mining industry at the Ender Settling Works in Salzberg bei Hallstatt.** Szombathy, J. Translated by R. G. Mansfield from *Mitt. Anthropol. Ges. Wien;* **20**: No. 5, 203-205(1900). 3p. Dep. NTIS $4.50.

Archaeological specimens found in prehistoric mines in the Hallstatt salt deposit, Austria, are described. (CH)

11462 (ORNL-tr—4032) **Mining operations of 2700 years ago.** Morton, F. Translated by R.G. Mansfield from *Montan-Ztg.;* **67**: No. 1, 9-11(Jan 1951). 4p. Dep. NTIS $4.50.

Archaeological specimens found in prehistoric mine workings of the Hallstalt salt deposit, Austria, are described. (CH)

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 11441

11463 (LBL—4445) **Investigation of radon-222 in subsurface waters as an earthquake predictor.** Smith, A.R.; Bowman, H.R.; Mosier, D.F.; Asaro, F.; Wollenberg, H.A.; King, C.Y. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 15p. (CONF-751116—28). Dep. NTIS $3.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

Changes of radon-222 content of well waters in seismically active regions may provide earthquake precursor signals, according to reports of recent Chinese and Russian work. A high-precision γ-ray system for continuous monitoring of radon in wells and springs has been developed at the Lawrence Berkeley Laboratory, where monitoring began in April 1975, and has been extended to other sites including the San Andreas fault zone. (auth)

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 11443, 11465

11464 (EUR—5241f) **Geochemistry of mercury and environmental pollution.** Van Wambeke, L. (Commission of the European Communities, Brussels (Belgium)). 1975. 35p. (In French). Dep. NTIS (US Sales Only) $4.00. EUR FB 210,-.

A close relationship exists between the geochemical distribution of mercury in the earth's crust and environmental pollution by mercury, natural or due to the use of raw materials and fossil fuels. The pollution level may reach abnormal values in the mercuriferous provinces and in particular in mercury mining districts where this element may produce toxic effects on man. The contribution of raw materials and fossil fuels to environmental pollution by mercury is also analysed on a worldwide basis and on the European Community level. By 1980, in the Community alone, 500 to 700 tonnes of mercury, about 1/3 of the present primary consumption could be recovered each year, as a result of anti-pollution measures. (auth)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 10451, 11443, 11468, 11657

11465 (IDO—22055) **Hydrologic data for the Idaho National Engineering Laboratory site, Idaho.** Barraclough, J.T.; Jensen, R.G. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Jan 1976. 52p. Dep. NTIS $5.50.

The Idaho Chemical Processing Plant (ICPP) discharges low-level waste and chemical waste directly to the Snake River Plain aquifer through a 600-foot (180 meter) disposal well. Most of the radioactivity is removed by distillation and ion exchange prior to being discharged into the well. During 1971 to 1973, the well was used to dispose of 404 curies of radioactivity, of which 389 curies were tritium (96 percent). The average yearly discharge was about 300 million gallons (1.1 x 10^9 liters). The distribution of waste products in the Snake River Plain aquifer covers about 15 square miles (30 square kilometers). Since disposal began in 1952, the wastes have migrated about 5 miles (8 kilometers) downgradient from discharge points. The perched ground-water body contains tritium, chromium-51, cobalt-60, and strontium-90. Radionuclides are subject to radioactive decay, sorption, and dilution by dispersion in the aquifer. Chemical wastes are subject to sorption and dilution by dispersion. Waste plumes south of the ICPP containing tritium, sodium, and chloride have been mapped and all cover a similar area. The plumes follow generally southerly flow lines and are widely dispersed in the aquifer. The waste plume of strontium-90 covers a much smaller area of the aquifer, about 1.5 square miles (4 square kilometers). Based on the relatively small size of the plume, it would appear that the strontium-90 is sorbed from solution as it moves through the Snake River Plain aquifer. (auth)

11466 (LA-UR—76-318) **Summary of recent studies of soil plutonium in the Los Alamos and Trinity Site environs.** Nyhan, J.W.; Hakonson, T.E. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-eng-36. 56p. (CONF-760214—2). Dep. NTIS $4.50.

From Conference on actinide sediment reaction; Richland, Washington, United States of America "USA" (10 Feb 1976).

The first plutonium was sent to the Los Alamos Scientific Laboratory (LASL) in 1944 from the Oak Ridge and Hanford reactors for use in synthesizing the first atomic bomb, which was subsequently detonated at Trinity Site in New Mexico. During the last 32 years the LASL has developed an outstanding capability in many scientific fields required to support research in weapons technology and in other uses of nuclear energy. The fabrication and experimental activities required for this effort have resulted in additions of plutonium in industrial effluents to Los Alamos soils, just as the Trinity soils received fallout plutonium after the 1945 Trinity detonation. Formal radioecology-soils studies relative to soil-actinide relationships has been mainly field-oriented and complements transuranic research dealing with the biota of several study areas. The current soil actinide research performed within three liquid effluent-receiving areas at Los Alamos and along the fallout pathway of Trinity, the first nuclear detonation, are summarized.

SOIL

11467 (DP-MS—75-118) **Actinide-soil interactions in waste management at the Savannah River Plant.** Holcomb, H.P.; Horton, J.H.; Wilhite, E.L. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1976. Contract AT(07-2)-1. 52p. (CONF-760214—1). Dep. NTIS $4.50.

From Conference on actinide sediment reaction; Richland, Washington, United States of America "USA" (10 Feb 1976).

Three aspects of the transuranium (TRU) nuclide-soil interaction were studied in connection with Savannah River Plant (SRP) burial ground operations. Results of the studies are reported as three separate parts of this report. (auth)

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 11626

11468 (COO—2447-4) **Behavior of technetium-99 in soils and plants.** Gast, R.G. (Minnesota Univ., St. Paul (USA). Dept. of Soil Science). 1976. Contract AT(11-1)-2447. 43p. Dep. NTIS $4.00.

Work described in this report is aimed at establishing the magnitude and mechanisms of ^{99}Tc sorption by soils and uptake by plants. Studies showed that sorption of ^{99}Tc by soils was essentially stopped by sterilization of the soil, further indicating that the sorption process is related to microbial activity. Studies also showed that sorption can occur under aerobic as well as anerobic conditions. However, there was considerable difference in the extent of sorption for different soils which remains to be explained. ^{99}Tc was shown to be toxic to germinating seeds at low concentrations, but not when added to more mature plants. Initial evidence suggests this is a chemically rather than a radiologically induced toxicity but this remains to be completely resolved as well as whether there is a threshold level of ^{99}Tc required before toxicity occurs. (auth)

11469 **Hypothetical radiation dose from tritiated oil shale gasoline.** Sweeton, F.H.; Barton, C.J. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; **22**: 2-3(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 11413

11470 (NERC-LV—539-29) **Tissue burdens of selected radionuclides in beef cattle on and around the Nevada Test Site.** Smith, D.D.; Black, S.C.; Giles, K.R.; Bernhardt, D.E.; Kinnison, R.R. (Environmental Protection Agency, Las Vegas, Nev. (USA). Environmental Monitoring and Support Lab.). Jan 1976. Contract AT(26-1)-539. 90p. Dep. NTIS $5.45.

During 1972, cattle from three different herds on and around the Nevada Test Site were sampled to determine the tissue burdens of plutonium and uranium. The only other isotopes detected in tissues were ^{90}Sr, ^{131}I, ^{137}Cs, and ^{3}H, although ^{95}Zr, ^{103}Ru, ^{140}Ba, and ^{141}Ce were frequently found in rumen contents. The herds sampled were: a control herd from Searchlight, Nevada; a herd from Area 18, the Nevada Test Site; and a herd grazing in the Operation Roller Coaster Area of the Tonopah Test Range, where four chemical detonations involving plutonium were conducted in 1963. (auth)

11471 (NTIS/PS—75/748) **Power plant siting. A bibliography with abstracts. Search period covered: 1964—September 1975.** Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Oct 1975. 145p. NTIS $25.00.

Abstracts pertaining to the siting of nuclear power plants, solar thermal power plants, ocean thermal gradient power plants, and coal fired utilities are presented. Emphasis is on nuclear power plant siting and includes siting of underground nuclear facilities. Areas covered include geology, seismology, safety, social effects, economics, and environmental impacts. Abstracts dealing with the siting of power plants in countries other than the U. S. are included. 96 abstracts. (NTIS)

REGULATIONS

REFER ALSO TO CITATION(S) 10835, 10838, 10854, 12320

ENVIRONMENTAL SCIENCES, AQUATIC

REFER ALSO TO CITATION(S) 10842, 11436

11472 **PROCEEDINGS OF THE SEVENTEENTH CONFERENCE ON GREAT LAKES RESEARCH HELD IN HAMILTON, ONTARIO, 12—14 AUGUST 1974.** Ann Arbon, MI; International Association for Great Lakes Research (1974). 845p. (CONF-740813—P1-P2).

From 17. conference on Great Lakes research; Hamilton, Ontario, Canada (12 Aug 1974).

Separate abstracts were prepared for three of the papers, two for inclusion in NSA and one for inclusion in ERA. Three papers were abstracted previously and appeared in NSA Vol. 30 as numbers 23998 and 29462 and in Vol. 32 as number 24333. (CH)

BASIC STUDIES

REFER ALSO TO CITATION(S) 10839, 11438

11473 (PB—239790) **Transport processes of particles in dilute suspensions in turbulent water flow. Phase III. Research report.** Jones, B.G.; Howard, N.M.; Meek, C.C.; Tomkins, J. (Illinois Univ., Urbana (USA). Water Resources Center). Dec 1974. Contract DI-14-31-0001-3582. 110p. (UILU-WRC—74-0091). NTIS $5.25.

Understanding the basic mechanisms and predicting the behavior of particles suspended in turbulent fluid flow are essential

to environmental conservation and to multiphase system design. Air and water pollution, sedimentation and erosion of riverbeds and coastal shorelines, and atmospheric fallout are some of the areas in which particle suspensions are of key importance. Detailed experimental measurements of dilute particle suspensions have been performed which examined the effects of particle size, shape and relative density on the statistical response of such particles in a turbulent fluid. Shape was found to be of minor importance for spheres, cubes and tetrahedrons. However, size was found to be important when the particle dimension was as large or larger than the fluid turbulence structure. Relative density influenced both free fall and inertial effects. An analytical model was developed which included these latter effects. It agrees well with observed particle dispersion measurements. (GRA)

11474 (PB—240302) **Transverse mixing of heated effluents in open-channel flow.** Yeh, T.P. (Iowa Univ., Iowa City (USA). Dept. of Mechanics and Hydraulics). May 1974. Contract DI-14-31-001-3692. 200p. NTIS $7.00.

Thesis. Also includes OWRT-C-3140(3692)(1).

The goal of the study is to investigate the transverse mixing process for a buoyant effluent in both near and far field regions of an open-channel flow. A set of laboratory flume experiments was performed, covering a range from very rapidly mixing flows to nearly stable stratified flows. In the experiments a heated effluent was introduced continuously into the flume over the depth of flow at the average ambient velocity from a source located at either the centerline or one side. Detailed measurements of the temperature distribution were obtained at several downstream cross sections. For some selected representative flow conditions, velocity profiles for both longitudinal and lateral components were also measured. The results show that the mixing process is closely related to the development and decay of buoyancy-generated secondary flow. (GRA)

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 11441, 11479

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 10273, 10274, 10867, 11443, 11481

11475 (CONF-750980—1) **Method for estimating the toxicity of chlorinated discharges.** Mattice, J.S. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 1975. 18p. Dep. NTIS $4.00.

From Workshop on impact of power plants on aquatic systems; Pacific Grove, California, USA (28 Sep 1975).

A recently developed procedure for site specific testing of chlorine toxicity both within a facility and its discharge is described. In order to evaluate the ecological effect of a proposed chlorination, it is necessary to know the vulnerability of fresh water organisms to chlorine exposures. Existing data regarding chlorine toxicity to freshwater organisms is presented for 64 species, of which 8 are algae, 27 are invertebrates, 28 are fish, and 1 an amphibian. The thresholds drawn indicate that for concentrations greater than 0.0015 mg/l increase in time of exposure generally increases the toxicity of chlorine. For concentrations less than 0.0015 mg/l, however, toxicity is no longer time-dependent and exposure for infinite time would not result in death. Evaluation of a given exposure to chlorine can be made by comparing a dose-time combination with the toxicity thresholds. (CH)

11476 (EUR—5377e) **European Community study on the determination of cyanides, phenols, and hydrocarbons in surface water. Report of a Working Group of Experts.** (Commission of the European Communities, Luxembourg. Directorate for Health Protection). 1975. 78p. Dep. NTIS (US Sales Only) $5.00. EUR pounds1.40.

With the participation of 34 laboratories from 8 Member States of the European Community a preliminary collaborative study on the detection of cyanides, phenols and hydrocarbons in surface water was conducted. The samples were received by nearly all participants within 6 days of shipment, only the transport to 7 participants taking a longer time. With a few exceptions the variation in temperature during transport was relatively small. Each participating laboratory chose the method of analyzing the samples. An appraisal of the particular methods could not be done. In detail the evaluation showed that the determination of hydrocarbons and cyanides in surface water may lead to considerably different results. In higher concentration ranges (>1 mg CN^-/l) the results of the measurements of cyanide content were in better agreement. In the concentration range given in this study the determinations of phenol showed the smallest variation of all parameters studied. In general the results of the multiple determinations of all parameters by the individual laboratories agreed fairly well.

11477 (PB—238612) **Development document for effluent limitations guidelines and new source performance standards for the petroleum refining point source category. Final report.** Halper, M. (Environmental Protection Agency, Washington, D.C. (USA)). Apr 1974. 207p. (EPA—440/1-74-014). NTIS $5.25.

This development document presents the findings of an extensive study of the Petroleum Refining Industry for the purposes of developing effluent limitation guidelines, standards of performance, and pretreatment standards for the industry to implement Sections 304, 306 and 307 of the Federal Water Pollution Control Act of 1972, (PL 92-500). Guidelines and standards were developed for the overall petroleum refining industry, which was divided into five subcategories. Effluent limitation guidelines contained herein set forth the degree of reduction of pollutants in effluents that is attainable through the application of best practicable control technology currently available (BPCTCA), and the degree of reduction attainable through the application of best available technology economically achievable (BATEA) by existing point sources for July 1, 1977, and July 1, 1983, respectively. Annual costs for the petroleum refining industry for achieving BPCTCA Control by 1977 and 1980 are estimated. Supporting data and rationale for the development of proposed effluent limitation guidelines and standards of performance are contained in this development document. Processes, control technology, and costs are also discussed. (GRA)

11478 (UCRL—51949) **Methodology for impact assessment in the estuarine/marine environment.** Haven, K.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Oct 1975. Contract W-7405-Eng-48. 45p. Dep. NTIS $4.00.

Impacts on the estuarine/marine environment can be assessed in economic terms by tracing the impact flow out of the economic sector through the marine environment and back into the economic sector as changes in natural resource availability. An impact can then be measured by the changes created in the economic sector by changes in resource availability. Primary emphasis is placed on the development of an appropriate ecological model of the estuarine environment for this purpose. Two types, an ecological input/output model and a dynamic (difference equation) model, are proposed. Acceptability criteria for these models include the ability to track lethal and sublethal, direct and indirect (food web), and short- and long-term effects of a variety of pollutants related to the production and use of various energy resources. (auth)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 10451, 11443, 11657

11479 (BNWL-SA—5630) **"Filter-resin" sampling method for measurement of radioactivity in Columbia River water.** Fix, J.J.; Robertson, D.E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1976. 7p. (CONF-760202—26). Dep. NTIS $3.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Several radionuclides present in Columbia River water have been measured since 1973 by using a filter-resin sampler to remove most radionuclides from the water during biweekly sampling periods and by counting directly and separately the filters and resin with a high sensitivity multi-dimensional (coincidence) gamma ray spectrometer. Insoluble (collected on filters) and soluble (adsorbed onto resin) concentrations of several radionuclides are observed and used to determine the probable origin of the activity. To date, all of the observed concentrations are less than 0.01 percent of the most restrictive ERDA Manual Chapter 0524 guidelines for drinking water. (auth)

11480 **Studies of plutonium cycling and sedimentation in Lake Michigan.** Wahlgren, M.A.; Nelson, D.M. (Argonne National Lab., IL). pp 212-218 of In Proceedings of the seventeenth conference on Great Lakes research. Ann Arbon, MI; International Association for Great Lakes Research (1974).

From 17. conference on Great Lakes research; Hamilton, Ontario, Canada (12 Aug 1974).

See CONF-740813—P1.

Estimates of cumulative deposition, together with the results of extensive lakewide sampling in 1972, yielded estimates of mean halftimes for removal from the water column of Lake Michigan of

1.0 +- 0.3 yr for ^{239,240}Pu, and 1.4 +- 0.3 yr for ^{137}Cs. However, data from 1971, 1972 and 1973 water samples indicate that the recent half-time is much greater than the 1963-1972 average, presently being on the order of 3 to 4 yrs for both ^{239}Pu and ^{137}Cs. The longer turnover time is consistent with the ^{137}Cs turnover time in the water column deduced from analysis of preserved Lake Michigan alewives. Water filtration experiments have demonstrated that greater than or equal to 75 percent of the plutonium is nonfilterable and is present as colloid or sub-colloidal sized fractions. At an offshore station near Grand Haven, Michigan, the concentration of ^{137}Cs in the epilimnion underwent a slight but significant decline from June to November, whereas ^{239}Pu was reduced to a small fraction of its spring value. In net plankton samples dominated by phytoplankton a much lower mean ^{137}Cs:^{239}Pu ratio is observed than in water samples, indicating a preferential sorption of ^{239}Pu over ^{137}Cs by phytoplankton. The results of these experiments suggest that sorption by phytoplankton (and the subsequent rapid settling from the epilimnion of phytodetritus and/or zooplankton fecal pellets) is responsible for the rapid removal of ^{239}Pu from the epilimnion. (auth)

WATER

REFER ALSO TO CITATION(S) 10342

AQUATIC ECOSYSTEMS AND FOOD CHAINS

11481 (ORO—4939-3) **Development of biological indices for identifying and evaluating impacts of pollutants on freshwater ecosystems. Annual progress report, June 1, 1975—February 28, 1976.** Cairns, J. Jr.; Benfield, E.F.; Buikema, A.L. Jr.; Dickson, K.L.; Hendricks, A.C. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). 1976. Contract E(40-1)-4939. 50p. Dep. NTIS $4.00.

The overall objective of this joint research effort was to devise and evaluate biological methods for determining the functional response of aquatic organisms to perturbations. The research effort fell into four general categories: structural and functional aspects of autotrophic and heterotrophic attached microbial communities in lotic systems with emphasis on carbon, nitrogen, and sulfur. The uptake of carbon, nitrogen, and sulfur under controlled and field situations was investigated along with biomass, ATP, and chlorophyll measurement. Relationship of protozoan invasion and extinction rates to the eutrophication process. Protozoan invasion and extinction rates (utilizing artificial substrates) were measured under oligotrophic and eutrophic conditions in numerous lakes and reservoirs. Behavioral responses of zooplankton subjected to cooling water entrainment. Zooplankton were subjected to various conditions that would be encountered during entrainment in order that the responses of the organisms might be ascertained. Detritus processing by macroinvertebrates as a pollutional stress assessment technique. Exposed measured units of detrital material to pollutional stress through time and compared their rates of processing to processing rates of similar units that were not exposed to the stress. (auth)

THERMAL EFFLUENTS MONITORING AND TRANSPORT

11482 (CONF-750980—2) **Impact of power plants on aquatic systems: a social perspective.** Coutant, C.C. (Oak Ridge National Lab., Tenn. (USA)). 1975. 8p. Dep. NTIS $3.50.

From Workshop on impact of power plants on aquatic systems; Pacific Grove, California, USA (28 Sep 1975).

Topics discussed are: aquatic effects of thermal electric power stations; legal aspects of water pollution; EPA provisions for levels of thermal discharges to assure protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in a body of water; cost benefit analysis of steam electric power effluents; cooling systems and siting of power plants; simulation modeling of population dynamics; and sociological aspects of water pollution. (HLW)

11483 (PB—240757) **Heat exchange and transport in the environment. Progress report No. 14.** Edinger, J.E.; Brady, D.K.; Geyer, J.C. (Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Geography and Environmental Engineering). Nov 1974. 139p. NTIS $5.75.

See also report dated Nov 1974, PB—240756, and report dated Dec 1974, PB—240758.

Man's thermal discharges are discussed in the context of earth's overall heat balance. Field data from about twenty lakes, rivers and estuaries are analyzed to demonstrate the validity of a simplified and refined theory of surface heat exchange that combines the heat dissipation roles of evaporation, conduction and back radiation into a single exchange coefficient. The equilibrium temperature concept is used to permit excess temperatures due to thermal discharges to be identified and analyzed. Manual techniques for estimating diurnal and seasonal fluctuations in water temperatures, including effects of ice cover, are exemplified. The role of longitudinal mixing in recirculated cooling lakes is analyzed. Various theoretical and empirical formulations for thermal plume shapes and trajectories are analyzed and summarized in terms of a general classification of hydrothermal problems and a unifying characterization of temperature distributions. (GRA)

11484 **Numerical model for thermal plumes and river discharges.** Paul, J.F.; Lick, W.J. (Case Western Reserve Univ., Cleveland). pp 445-455 of In Proceedings of the seventeenth conference on Great Lakes research. Ann Arbon, MI; International Association for Great Lakes Research (1974).

From 17. conference on Great Lakes research; Hamilton, Ontario, Canada (12 Aug 1974).

See CONF-740813—P1.

A numerical model for the time-dependent, three-dimensional variable-density flow from a horizontal rectangular discharge into a basin has been developed. Steady-state results are presented for representative flow conditions of the Cuyahoga River entering Lake Erie and of the Point Beach Power Plant thermal discharge into Lake Michigan. Results for three different cases of the Cuyahoga River are given. Two cases are for heated discharges at different flow rates entering a constant depth basin. The lower rate corresponds to flows typical of the late summer months and the higher flow rate corresponds to flows typical of the spring. The third case is for the low flow rate heated discharge entering a variable-depth basin. The depth variation is such that the basin depth doubles in two and one-half river widths and then remains constant. This depth variation is not realistic for the Cuyahoga River, but it is used to indicate the importance of the variable-depth basin. For the Point Beach thermal discharge calculation, the vertical eddy coefficient is assumed to be a function of the local vertical temperature gradient and the actual bottom topography is used. (auth)

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 11471

REGULATIONS

REFER ALSO TO CITATION(S) 10323, 10838, 11477, 12320

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 10648, 10786, 10787, 10795, 10796, 10812, 10813, 10815, 10816, 10817, 10850, 10859, 10865, 10899

BIOMEDICAL SCIENCES, BASIC STUDIES

REFER ALSO TO CITATION(S) 10839

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 11499, 11500

11485 (ANL—75-60(Pt.2), pp 74-84) **Cortical and trabecular bone mineral mass in the radius and ulna.** Schlenker, R.A.; VonSeggen, W.W. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

Sites in the distal radius used in the absorptiometric method of bone mineral mass measurement are often assumed to be predominantly trabecular bone. In order to determine the proportion of trabecular and cortical bone at these sites, we ashed and weighed the cortical and trabecular bone from 2-mm thick sections spaced approximately 2.5 mm apart in the most distal 12 cm of radii and ulnae from four women aged 21, 43, 63, and 85 years.

The proportion of trabecular bone was found to change rapidly as a function of position in the bone metaphyses, but remained relatively constant as a function of age. In the diaphyses, the proportion of trabecular bone remained relatively constant as a function of position but increased with age. Contrary to the assumption that distal measurement sites are predominantly trabecular bone, we found that trabecular bone varied between 10 percent and 50 percent of the total, depending on the exact location of the site. (auth)

11486 Kinetics and mechanism of the reduction of horse heart ferricytochrome c by chromium(II) at low pH. Przystas, T.J.; Sutin, N. (Brookhaven National Lab., Upton, NY). *Inorg. Chem.;* **14**: No. 9, 2103-2110(1975).

The rate constant for the reduction of ferricytochrome c by chromium (II) at 25° is $(40/[H^+] + 3.6 \times 10^2 + 4.7 \times 10^3[H^+])$ M^{-1} sec^{-1} in 1.0 M chloride at $[H^+] = 0.003$-0.20 M and $(3.2/[H^+] + 10)$ M^{-1} sec^{-1} in 0.1 M perchlorate at $[H^+] = 0.006$-0.08 M. The addition of thiocyanate ions to the reactant solutions markedly increases the reaction rate, and the third-order rate constant for the thiocyanate-assisted reaction at $[H^+] = 0.006$-0.05 M is $(1.1 +- 0.2) \times 10^6$ M^{-2} sec^{-1} in 1.0 M chloride and $(2.3 +- 0.4) \times 10^6$ M^{-2} sec^{-1} in 0.1 M chloride. The reaction in chloride media is postulated to occur by an inner-sphere mechanism with a transition state [Fe-Cl-Cr]. The thiocyanate-assisted reaction is thought to occur mainly by an outer-sphere mechanism, with electron transfer taking place through the porphyrin ring system. However, the detection of an unstable chromium (III) product containing thiocyanate bound to the chromium through the sulfur indicates that part of the thiocyanate-assisted reaction proceeds through an inner-sphere mechanism with a transition state [Fe-NCS-Cr]. The same unstable chromium (III) product is formed in the reaction of chromium (II) with tetrakis(4-pyridyl) porphineiron (III) chloride in chloride or perchlorate media containing added thiocyanate. (auth)

11487 Solution conformation of Bradkinin and certain fragments. Cann, J.R.; Stewart, J.M.; London, R.E.; Matwiyoff, N. (Univ. of Colorado Medical Center, Denver). *Biochemistry;* **15**: No. 3, 498-504(10 Feb 1976).

A circular dichroism (CD) study of [D-Pro^2]- and [D-Pro^3]-bradykinin, selected peptide fragments, and the model compound, N-acetyl-L-phenylalaninamide, support our previous conclusion (Biochemistry 12, 3780, 1973) that the positive 221-nm CD band of bradykinin is a composite of bands due to two chromophores, the 217-nm band characteristics of the Phe residues overlying the 223-nm band of the N-terminal sequence, Arg-Pro-Pro. The results also indicate that the 223-nm band of Arg-Pro-Pro is associated with the configuration of the Pro-Pro sequence, Arg-D-Pro-Pro and Arg-Pro-D-Pro virtually being diastereoisomers. Accordingly, the conformation of Arg-Pro-Pro was probed in further detail. Upon increasing the temperature from about 27 to 65°C, Arg-Pro-Pro undergoes a conformational transition characterized by large positive values of ΔH° and ΔS°, which is interpreted to mean that the structure of water and, thus, solute-solvent interactions play a dominant role in determining the conformation of the peptide. ^{13}C nuclear magnetic resonance spectroscopy indicates that the effect of lowering the pH on the CD of Arg-Pro-Pro is explicable in terms of hydrogen-bond formation between the carboxyl group and Pro^2 carbonyl oxygen at acid pH with concomitant cis to trans isomerization. (auth)

11488 Biological activity of 1,25-dihydroxyvitamin D_3 in the chick. Jones, G.; Baxter, L.A.; DeLuca, H.F.; Schnoes, H.K. (Univ. of Wisconsin, Madison). *Biochemistry;* **15**: No. 3, 713-716(10 Feb 1976).

1,25-Dihydroxyvitamin D_3 has been prepared from 25-hydroxyvitamin D_3 using rachitic chick kidney mitochondria. This metabolite was highly purified by Sephadex LH-20 chromatography and by preparative high-presure liquid chromatography. Its purity was assessed by analytical high-pressure liquid chromatography which revealed no other 254-nm absorbing material and by mass spectrometry. The concentration of dilute solutions of 1,25-dihydroxyvitamin D_3 was determined by high-pressure liquid chromatography and deflection of the 254-nm column monitor. The 1,25-dihydroxyvitamin D_3 was then shown to be $^1/_5$ to $^1/_{10}$ as active as 1,25-dihydroxyvitamin D_3 in the chick while it had previously been shown to be equal in activity in the rat. Thus, discrimination against the vitamin D_3 side chain by the chick persists in the metabolically active 1,25-dihydroxyvitamin D compounds. (auth)

11489 Comparative studies on monotypic IgMλ and IgGk from an individual patient. II. Amino-terminal sequence analyses. Hopper, J.E.; Noyes, C.; Heinrikson, R.; Kessel, J.W. (Univ. of Chicago). *J. Immunol.;* **116**: No. 3, 743-746(Mar 1976).

Amino terminal sequence analyses were performed on the H and L chains of the idiotypically related IgMλ and IgGκ paraproteins isolated from the sera of a patient, Br. The N-terminal 41 residues of the Br κ-chain belonged to the V/sub KIII/ subgroup, and L chains derived from BrIgMλ revealed a blocked N-terminus characteristics of λ-chains. Comparative sequence analysis of the Br μ- and γ-chains indicated that, although both possessed an unblocked N-terminal glutamic acid, the respective V/sub H/ regions belonged to separate subgroups. The N-terminal 27 residues of the Br μ-chain reflected a typical V/sub HIII/ subgroup sequence. The Br γ-chain sequence demonstrated a V/sub HI/ pattern with an unblocked N-terminus. These structural data stand in contrast to previously reported serologic evidence, which indicated that the BrIgMλ and BrIgGκ proteins possessed highly similar V/sub H/-associated idiotypic determinants. Final interpretation of these findings of similar V/sub H/ idiotypic determinants expressed by H chains belonging to separate V/sub H/ subgroups must await complete sequence analysis of the hypervariable segments of the Br γ- and μ-chains. (auth)

11490 ^{31}P nuclear magnetic resonance chemical shielding tensors of phosphorylethanolamine, lecithin, and related compounds: applications to head-group motion in model membranes. Kohler, S.J.; Klein, M.P. (Univ. of California, Berkeley). *Biochemistry;* **15**: No. 5, 967-973(9 Mar 1976).

^{31}P nuclear magnetic resonance (NMR) power spectra have been used to obtain the principal values of the chemical shielding tensors of dipalmitoyllecithin (DPL), dipalmitoylphosphatidylethanolamine, and several related organophosphate mono- and diesters. In addition, the principal values and orientation of the phosphorylethanolamine shielding tensor were determined from ^{31}P NMR spectra of a single crystal. In all compounds studied the shielding tensors were clearly nonaxial. The monoester spectra are typified by the spectrum of phosphorylethanolamine with principal values of -67, -13, and 69 ppm relative to H_3PO_4. The diesters have a larger total anisotropy, as indicated by the DPL values of -81, -25, and 108 ppm. These data as well as the orientation of the phosphorylethanolamine shielding tensor are correlated with the electron density distribution as determined by the bonding pattern of the phosphate. The spectrum of a DPL—water (1:1) mixture at 52°C has a shift anisotropy of 30 ppm and displays a shape characteristic of an axial tensor. This change from the rigid lattice DPL pattern is explained in terms of motional narrowing, and the shielding tensor data are used to interpret the motion of the phospholipid head group. Simple rotation about the P—O(glycerol) bond is excluded, and a more complex motion involving rotation about both the P—O(glycerol) and glycerol C(2)—C(3) bonds is postulated. (auth)

11491 Structure of the concanavalin A—methyl α-D-mannopyranoside complex at 6-A resolution. Hardman, K.D.; Ainsworth, C.F. (Thomas J. Watson Research Center, Yorktown Heights, NY). *Biochemistry;* **15**: No. 5, 1120-1128(9 Mar 1976).

The carbohydrate binding site of concanavalin A has been identified in crystals of the concanavalin A-methyl α-D-mannopyranoside complex and is 35 A from the iodophenol binding site (K. D. Hardman and C. F. Ainsworth (1973), Biochemistry 12, 4442), which has been postulated to be adjacent to the carbohydrate-specific binding site (Edelman et al. (1972), Proc. Natl. Acad. Sci. U.S.A. 69, 2580). The crystals are orthorhombic in space group C222/sub l/ and crystal density measurements indicate a protein mass of four monomers (molecular weight of 104,000) per asymmetric unit. However, the electron density map contains eight monomers/asymmetric unit, revealing lattice disorder. The electron density map with a nominal resolution of 6 A has been solved using three heavy-atom derivatives and the position and orientation of each monomer established. Atomic coordinates of the native protein which has previously been determined (K. D. Hardman (1973), Adv. Exp. Med. Biol. 40, 103) were transposed into this new space group and the gross conformations of the monomers, dimers, and tetramers were found to be very similar to the previous structure. However, some minor differences were apparent even at this resolution. After crystal growth, the methyl α-D-mannopyranoside was replaced by o-iodophenyl β-D-glucopyranoside or methyl 2-iodoacetimido-2-deoxy-α-D-glucopyranoside in separate experiments,and difference electron density maps were calculated. The highest peaks for both iodinated sugar derivatives associated with each monomer agreed within a few angstroms of each other and were found near side chains Tyr-12 and -100 and Asp-16 and -208. This region is 10 to 14 A from the manganese, in good agreement with nuclear magnetic resonance (NMR) studies in solution (C. F. Brewer et al. (1973), Biochemistry 12, 4448) and with the site predicted from cross-linked I222 crystal studies (K. D. Hardman (1973), Adv. Exp. Med. Biol. 40, 103). (auth)

11492 Studies on human serum high-density lipoproteins. Self-association of human serum apolipoprotein A-II in aqueous solu-

tions. Vitello, L.B.; Scanu, A.M. (Univ. of Chicago). *Biochemistry;* **15**: No. 5, 1161-1165(9 Mar 1976).

Some of the solution properties of pure preparations of human serum high-density apolipopoprotein A-II were studied by sedimentation equilibrium ultracentrifugation, conducted at different apoprotein concentrations and at several speeds. The concentration dependence of the apparent weight average molecular indicated that apolipoprotein A-II, when dissolved in 0.02 M EDTA (pH 8.6), undergoes self-association. Over a protein concentration range between 0.8 and 1.5 mg/ml, the self-association could best be described by a monomer-dimer-trimer step association, although indefinite self-association could not be ruled out. The equilibrium constants obtained were sufficient to describe the system over the concentration range investigated. (auth)

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 11527, 11528

CYTOLOGY

REFER ALSO TO CITATION(S) 11401, 11402, 11578

11493 Method and apparatus for determination of nuclear and cytoplasmic size in biological cells. Steinkamp, J.A.; Crissman, H.A. (to U.S. Energy Research and Development Administration). US Patent Application 582,056. Filed date 29 May 1975. 11p.

A technique was developed for rapid measurement of nuclear and cytoplasmic size relationships in single mammalian cells. The technique makes use of flow microfluorometry and is based on quantitative fluorescence staining of either the nucleus alone for deoxyribonucleic acid (DNA) content or in combination with total protein using two-color fluorescence methods. It permits simultaneous measurement of nuclear and cytoplasmic diameter, DNA content, total protein, and whole cell size, plus ratios of these parameters.

11494 Microscopic protein structure of the lens with a theory for cataract formation as determined by Raman spectroscopy of intact bovine lenses. Schachar, R.A.; Solin, S.A. (Univ. of Chicago). *Invest. Ophthalmol.;* **14**: No. 5, 380-396(May 1975).

Intact bovine lenses have been studied using the polarized Raman spectroscopic technique. A brief theoretical and experimental review of Raman spectroscopy is presented. From the dependence of the Raman depolarization ratio on the propagation direction of the incident radiation we have determined that the uniaxial qualities of the lens result from microscopic anisotropy and have established the quantitative positional correlation of specific chemical bonds with respect to the lens optic axis. In particular, the hydrogen bonded linear CONH groups of the antiparallel β-pleated sheet are preferentially oriented in directions orthogonal to the lens optic axis. The Raman spectra of intact lenses do not exhibit bands at positions characteristic of either the α-helix or the random coil protein structure. The antiparallel β-pleated sheet protein microstructure and the lens fiber cross-sectional macrostructure exhibit a remarkable similarity. This similarity may be causal and is consistent with the protein concentration of the lens, the birefringent properties observed by both Lenhard and Brewster, the CONH bond angle distribution with respect to the optic axis, and the lens anatomy. It is suggested that cortical cataracts are caused by fluctuations in protein orientational order. (auth)

11495 Isolation of variant lymphoma cells with reduced growth requirements for extracellular calcium and magnesium and enhanced oncogenicity. Brennan, J.K.; Lichtman, M.A.; Chamberlain, J.K.; Leblond, P. (Univ. of Rochester, NY). *Blood;* **47**: No. 3, 447-459(Mar 1976).

By exposing an established cell line of malignant mouse lymphocytic cells (L5178Y) to a culture environment low in calcium and magnesium, we have isolated and maintained in continuous culture a variant population with reduced growth requirements for the cations. The variant cells are larger, have enhanced aggregability, tend to form dispersed colonies in semisolid medium, and have increased oncogenicity. Variants and their progenitors share similar morphology, maximum proliferative rate, and stability of phenotype. The significance of these findings is discussed and an analogy suggested between the selective influence of calcium and magnesium deprivation in vitro and the evolution of thymic dysplasias in divalent cation-deprived rodents. (auth)

GENETICS

11496 Histocompatibility-2 system in wild mice. II. H-2 haplotypes of t-bearing mice. Hammerberg, C. (Univ. of Michigan, Ann Arbor); Klein, J.; Artzt, K.; Bennett, D. *Transplantation;* **21**: No. 3, 199-212(Mar 1976).

As a first step in the study of the possible relationship between the T/t and H-2 complexes, the H-2 antigenic composition of the strains carrying factors t^{12}, t/sup w32/, t/sup w2/, t/sup w8/, t^1, t^9, t^6, t/sup w1/, t/sup w71/, t/sup w73/, t/sup w12/, t/sup w5/, t/sup w75/, and t^{28}, was studied by using a battery of antisera containing antibodies against inbred-derived H-2 antigens. In addition, five t strains (t^{12}, t^9, t/sup w5/, t/sup w1/, and t/sup w2/) were selected for the production of antisera against the H-2 complexes carried by t chromosomes. Spleen, lymph node, and thymus cells from H-2/sup b//t heterozygotes and t/sup w2//t/sup w2/ homozygotes were injected into appropriate F_1 hybrids between two inbred strains that carried the inbred-derived H-2 antigens of the donor. Four new H-2 antigens and one Ia antigen were uncovered and were assigned the symbols H-2.106 through H-2.109, and Ia.101, respectively. Three new H-2 haplotypes were also described, based upon the H-2 antigenic pattern of three t factors, t^{12}, t/sup w1/, and t/sup w5/. These new haplotypes were given the symbols H-2/sup t12/, H-2/sup tw1/, and H-2/sup tw5/. When the t factors were grouped according to their H-2 haplotypes, their distribution, with certain exceptions, corresponded to the complementation groups. Thus, t chromosomes in the same complementation group carried similar, if not identical, H-2 haplotypes, despite the fact that these chromosomes were derived from widely separated geographic areas. Such an association between the t and H-2 complexes is most unusual in light of what is known of the polymorphism of H-2 halotypes in wild mice populations. It suggests more than a casual relationship, at least at the population level, between the t and H-2 loci. (auth)

METABOLISM

REFER ALSO TO CITATION(S) 11486

11497 (BNL—20912) **Skeletal mass in rheumatoid arthritis: a comparison with forearm bone mineral content.** Zanzi, I.; Roginsky, M.S.; Ellis, K.J.; Blau, S.; Cohn, S.H. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. 8p. (CONF-760123—1). Dep. NTIS $4.50.

From International conference on bone mineral measurement; New Orleans, Louisiana, United States of America ªUSAª (25 Jan 1976).

The evaluation of diffuse osteoporosis in patients with rheumatoid arthritis (RA) remains controversial. An important associated problem is the compounded effect of osteopenia secondary to chronic corticosteroid treatment. Photon-absorptiometric techniques have been utilized for measurements of selected sites of the skeleton, such as the distal femur and the distal radius. The development of the technique of in-vivo total body neutron activation analysis (TBNAA) along with whole body counting, has made possible the direct measurement of skeletal mass (total body calcium, TBCa). The TBCa and radial bone mineral content (BMC) were evaluated in 19 Caucassian women with R.A., with and without a history of corticosteroid treatment. (auth)

11498 Certain aspects of zinc metabolism in man. Spencer, H.; Osis, D.; Wiatrovski, E.; Coffey, J. (VA Hospital, Rines, IL). *Physiologist;* **17**: No. 3, (Aug 1974).

Zinc, an essential trace element, has been shown to be an important growth factor in man and to promote wound healing. In order to delineate the metabolism of zinc in man, metabolic balances of zinc were determined under strictly controlled dietary conditions by analyzing the dietary zinc intake and the excretions in each 6-day metabolic period. Zinc in the diet, urine, stool, and plasma was analyzed by atomic absorption spectroscopy. On a 12-14 mg dietary zinc intake per day, zinc is excreted mainly via the intestine. The urinary zinc excretion is low, about 0.5 mg/day, and the zinc balance is in equilibrium. Raising the dietary zinc intake to 22 mg/day or lowering it to 7 mg/day did not alter the metabolism of zinc. Loss of weight induced by dietary restriction or by total starvation markedly increased the urinary zinc excretion and resulted in a zinc loss of 10-15 percent of the total body stores of zinc. This marked loss of zinc was not associated with a decrease of the plasma levels of zinc and there was actually an increase of these levels. The studies indicate that during adequate nutrition the zinc balance is in equilibrium while catabolic states are associated with a loss of zinc which is not reflected by the plasma levels of zinc. (auth)

11499 Two electron donation sites for exogenous reductants in chloroplast photosystem II. Babcock, G.T.; Sauer, K. (Univ. of California, Berkeley). *Biochim. Biophys. Acta;* **396**: 48-62(1975).

EPR spectrometry and white light flashes were used to distinguish two sites for the oxidation of exogenous donors by Photosystem II in non-oxygen evolving spinach chloroplasts. In the presence of lipophilic donors (e.g. phenylenediamine, benzidine, diphenylcarbazide), the rate for Signal IIf rereduction following a flash increases as the concentration of exogenous reductant increases. There is a decrease (20—40 percent) in Signal IIf magnitude accompanying donor addition at low ($<10^{-5}$ M) concentrations, but the extent of the decrease does not change further with increasing donor concentration. Complementary polarographic experiments monitoring donor (phenylenediamine) oxidation show an increase in oxidation rate with increasing donor concentration. In the presence of the hydrophilic donor, Mn^{2+}, the Signal IIf decay halftime remains constant with increasing Mn^{2+} concentration. However, the flash-induced Signal IIF magnitude progressively decreases with increasing Mn^{2+} concentration. These results are interpreted in terms of two competing paths for the reduction of $P680^+$. In one path $P680^+$ reduction is accompanied by the appearance of Signal IIf and lipophilic donors subsequently rereduce the Signal IIf species in a series reaction. This reduction follows pseudo-first order kinetics as a function of donor concentration. In the second path Mn^{2+} reduces $P680^+$ in a parallel reaction that competes with the formation of the Signal IIf species. This results in a decrease in the magnitude of Signal IIf, but no change in its decay time. (auth)

11500 Effect of disalicylideneпropanediamine on the light-dependent reduction of carbon dioxide and glycerate 3-phosphate in intact spinach chloroplasts. Robinson, J.M.; Latzko, E.; Gibbs, M. (Brandeis Univ., Waltham, MA). *Plant Physiol.;* **55**: No. 1, 12-14(Jan 1975).

Disalicylidenepropanediamine (DSPD) at 0.1 to 1 mM levels inhibited light-dependent $^{14}CO_2$ assimilation in intact spinach chloroplasts about 50 to 80 percent, and this inhibition was accompanied by an increased ratio of ^{14}C-glycerate 3-phosphate to ^{14}C-glyceraldehyde 3-phosphate. Enzymatic analysis established that DSPD also inhibited the light-dependent reduction of glycerate 3-phosphate in intact spinach chloroplasts. DSPD at 0.5 mM did not inhibit ribose 5-phosphate isomerase, ribulose 5-phosphate kinase, glycerate 3-phosphate kinase, $NADP^+$-linked glyceraldehyde 3-phosphate dehydrogenase or ribulose 1,5-diphosphate carboxylase. The inhibition of chloroplast $^{14}CO_2$ assimilation by DSPD appeared to be related to the inhibition of the photosynthetic electron transport chain. These observations are consistent with experimental results which demonstrated that DSPD inhibited directly the chloroplast lamellar membrane-mediated, light-dependent reduction of ferredoxin. (auth)

MEDICINE

REFER ALSO TO CITATION(S) 11518, 11519, 11547

11501 Folded membrane dialyzer with mechanically sealed edges. Markley, F.W. (to U.S. Energy Research and Development Administration). US Patent Application 566,497. Filed date 9 Apr 1975. 23p.

A semipermeable membrane is folded in accordion fashion to form a stack of pleats and the edges are sealed so as to isolate the opposite surfaces of the membrane. The stack is contained within a case that provides ports for flow of blood in contact with one surface of the membrane through channels formed by the pleats and also provides ports for flow of a dialysate through channels formed by the pleats in contact with the other surface of the membrane. The serpentine side edges of the membrane are sealed by a solidified plastic material, whereas effective mechanical means are provided to seal the end edges of the folded membrane. The mechanical means include a clamping strip which biases case sealing flanges into a sealed relationship with end portions of the membrane near the end edges, which portions extend from the stack and between the sealing flanges.

11502 Role of the gonads in hypertension-prone rats. Dahl, L.K.; Knudsen, K.D.; Ohanian, E.V.; Muirhead, M.; Tuthill, R. (Brookhaven National Lab., Upton, NY). *J. Exp. Med.;* **142**: 748-759(1975).

A strain of hypertension-prone rats was studied to determine what role gonads play in the rate of development of hypertension. Castrated and intact rats were compared when fed high (8 percent) and low (0.3 percent) NaCl. Castration had no effect in the males but caused a rise in blood pressure in the females to level equal to that in males. It was suggested that this might provide further evidence on the nature of menopausal hypertension in humans. (JWP)

11503 Assay for erythropoietin in vitro at the milliunit level. Goldwasser, E.; Eliason, J.F.; Sikkema, D. (Univ. of Chicago). *Endocrinology;* **97**: No. 2, 315-323(Aug 1975).

A method is described for the assay of erythropoietin using primary cultures of adult rat bone marrow cells. Either total labeled iron uptake by the cells or hematin synthesis from labeled iron may be used as the measure of erythropoietin action. The method is useful in the range 0.001 to 0.010 U, where the log response is linear with the log dose, and can be carried out in 2 working days. This method has the disadvantage of detecting asialoerythropoietin which has no activity in vivo. (auth)

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 11346

11504 (CONF-760121—1) **Comparison of positron tomography and scintigraphy with ^{201}Tl for delineation of the myocardium.** Fill, H.; Buchin, M.; Harper, P.V.; Muehllehner, G.; Walsh, W.; Resnekov, L.; Mock, B. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1976. Contract E(11-1)-69. 13p. Dep. NTIS $3.50.

From 12. international symposium on radioactive isotopes in clinical medicine and research; Bag Gastein, Austria (12 Jan 1976).

Recent advances in nuclear medicine instrumentation have led to the development of improved positron-imaging systems which exceed in performance the earlier systems which were limited mainly by low count rate capability. This has led to renewed interest in positron imaging in general, primarily because such devices offer better resolution and higher sensitivity than conventional, mechanically collimated gamma cameras, as well as tomographic capability which may provide additional and more accurate information for the clinician. Furthermore, the unique capabilities of positrons for use in reconstructive imaging are beginning to be exploited. In the present report, results are presented from a preliminary study in which longitudinal tomographic myocardial images, produced with ^{81}Rb as the positron-emitting label using the double camera coincidence system are compared with conventional myocardial images obtained with ^{201}Tl and a gamma camera. (auth)

11505 (COO—2427-5) **Biologic considerations in anatomic imaging with radionuclides. Final progress report, July 1974—June 1975.** Potchen, E.J. (Johns Hopkins Univ., Baltimore, Md. (USA). School of Medicine). 1975. Contract E(11-1)-2427. 31p. Dep. NTIS $4.00.

An important task relating to anatomic imaging with radionuclides is the determination of factors which effect the use of imaging procedures. This is important to reduce radiation exposure in the population, to improve the efficacy of diagnostic imaging procedures and finally to provide a basis for evaluating the potential effects of proposed regulation of use rates. In this report we describe a methodology for obtaining clinical data relating to the use of the brain scan in an inner city teaching hospital. The development of a questionnaire suitable for use in a clinical setting and providing both prospective and retrospective data is presented. The results of the use of the questionnaire at the Johns Hopkins Hospital during a three month period in 1974 are shown and discussed. Some preliminary results from these data are given and a method for further analysis is indicated. (auth)

11506 (LA—6183-PR) **Serologic test development. Progress report, July 1, 1974—June 30, 1975.** Saunders, G.C.; Clinard, E.H.; Sanders, W.M.; Bartlett, M.L.; Payne, R.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-Eng-36. 16p. Dep. NTIS $4.50.

The Enzyme-Labeled Antibody (ELA) test system has been adapted to microtiter trays for both cell bound and soluble antigens. Problems involving both readout instrumentation and reaction product stability have been solved. Progress involving application of the ELA system for detection of hog cholera, trichinosis, swine brucellosis, and swine and bovine tuberculosis is reported. Prototype instrumentation for automating ELA processing is being developed. (auth)

11507 (LBL—4633) **Cerebral imaging using ^{68}Ga DTPA and the U.C.S.F. multiwire proportional chamber positron camera.** Hattner, R.S.; Lim, C.B.; Swann, S.J.; Kaufman, L.; Perez-Mendez, V.; Chu, D.; Huberty, J.P.; Price, D.C.; Wilson, C.B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1975. Contract W-7405-eng-48. 12p. (CONF-751116—34). Dep. NTIS $3.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

A multiwire proportional chamber positron camera consisting of four 48 x 48 cm^2 detectors linked to a small digital computer has been designed, constructed, and characterized. Initial clinical application to brain imaging using ^{68}Ga DTPA in 10 patients with brain tumors is described. Tomographic image reconstruction is accomplished by an algorithm determining the intersection of the annihilation photon paths in planes of interest. Final image processing utilizes uniformity correction, simple thresholding, and smoothing. The positron brain images were compared to conventional scintillation brain scans and x-ray computerized axial tomograms (CAT) in each case. The positron studies have shown significant mitigation of confusing superficial activity resulting from craniotomy in comparison to conventional brain scans. Central necrosis of lesions observed in the positron images, but not in the conventional scans, has been confirmed in CAT. Modifications of the camera are being implemented to improve image quality, and these changes combined with the tomography inhereat in the positron scans are anticipated to result in images superior in information content to conventional brain scans. (auth)

11508 (TID—26984) **Current status of diagnostic counting and imaging techniques used in nuclear medicine: a sketch.** Beck, R.N. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1975. 9p. Dep. NTIS $4.50.

Diagnostic procedures used in Nuclear Medicine are designed to provide information about the static and/or dynamic distribution of some particular stable or radioactive material within the patient, as well as the quantity of the material present. Thus, the static distribution of ^{131}I in the thyroid indicates the structure of the gland, whereas changes in the distribution or in the quantity present indicate its rate of functioning. A remarkable variety of techniques, based on emission, transmission, fluorescence, and incoherent holographic imaging principles, have been developed. Both moving and fixed radiation detectors are used, and these produce planar and 3-D projections and transverse sections of the object of interest. In general, the image quality is determined by detector characteristics such as sensitivity, spatial resolution, and depth of field, as well as by the examination time, object contrast, and object intensity, which is always severely limited in the interest of a low radiation dose to the patient. Image processing techniques can be used to improve image quality by removing certain artifacts and by producing a degree of sharpening that is limited by the signal-to-noise ratio. Incoherent holography and optimum-weighted multichannel imaging are presented as two approaches to increasing the signal-to-noise ratio. Alternative criteria for the evaluation of imaging procedures are presented, with emphasis on the use of ROC curves to describe observer performance. (auth)

11509 **Kit for the rapid preparation of /sup 99m/Tc red blood cells.** Richards, P.; Smith, T.D. (to U.S. Energy Research and Development Administration). US Patent Application 568,809. Filed date 16 Apr 1975. 10p.

A method and sample kit are described for the preparation of /sup 99m/Tc-labeled red blood cells in a closed, sterile system. A partially evacuated tube, containing a freeze-dried stannous citrate formulation with heparin as an anticoagulant, allows whole blood to be automatically drawn from the patient. The radioisotope is added at the end of the labeling sequence to minimize operator exposure. Consistent 97 percent yields in 20 minutes are obtained with small blood samples. Freeze-dried kits have remained stable after five months. (auth)

11510 **Adrenal imaging with ^{131}I-19-iodocholesterol in the diagnostic evaluation of patients with aldosteronism.** Seabold, J.E.; Cohen, E.L.; Beierwaltes, W.H.; Hinerman, D.L.; Nishiyama, R.H.; Bookstein, J.J.; Ice, R.D.; Balachandran, S.; (Univ. of Michigan, Ann Arbor). *J. Clin. Endocrinol. Metab.*; **42**: No. 1, 41-51(Jan 1976).

The results of adrenal scintiscans, venograms, and venous aldosterone levels are compared with the histologic findings in 33 patients submitted to operations for primary aldosteronism. Standard and suppression scintiscans were performed 2 to 14 days following intravenous administration of 2 mCi of ^{131}I-19-iodocholesterol. The adrenal lesions were histologically classified into four categories: 25 patients had adenomas, 6 had macronodular hyperplasia, 1 had microscopic hyperplasia, and 1 had an adenocarcinoma. Asymmetrical uptake between the two adrenals seen on standard scintiscans did not differentiate between a tumor or asymmetrical hyperplasia, unless the tumor was greater than 2 cm in diameter. During suppression scintiscans, unilateral uptake visible within five days of the tracer injection was consistent with adenoma. Patients with nodular hyperplasia demonstrated early uptake in both adrenal glands during suppression scintiscans, while the patient with microscopic hyperplasia did not. The type of adrenal lesion was correctly identified in 20/26 (77 percent) of patients by suppression scintiscans; 21/28 (75 percent) of patients by venograms and 12/16 (75 percent) of patients who had adrenal venous aldosterone measurements attempted. The majority of surgically correctible lesions could be identified on suppression adrenal scintiscans. Adrenal vein catheterization can be reserved for those patients in whom the results of suppression scintiscans are inconsistent with the clinical degree of aldosteronism. (auth)

11511 **Radionuclide liver scans in tumor detection. Current concepts.** Spencer, R.P. (Univ. of Connecticut Health Center, Farmington). *Cancer, Suppl.*; **37**: No. 1, 475-479(Jan 1976).

From ACS-NCI national conference on advances in cancer management. II. Detection and diagnosis; Denver, CO, USA (1 May 1975).

Because of the frequency of spread of tumors arising elsewhere to the liver, hepatic evaluation plays a key role in planning therapy. Dynamic radionuclide transit studies depend upon the dual blood supply of the liver (hepatic artery and portal vein) and can be a useful prelude to static imaging, as most intrahepatic tumors have an hepatic arterial blood supply. Since most tumors do not have the ability to accumulate a radioactive colloid, static views are usually obtained after injection of particulates, which are accumulated by the reticuloendothelial system. A gross defect on the radiocolloid scan simply indicates the presence of an intrahepatic abnormality, but does not identify the nature of the lesion. The possible role to be played by use of additional radiopharmaceuticals, with different properties, in identifying the intrahepatic process is discussed. Other uses of liver scans, such as in evaluating the response of known intrahepatic lesions to therapy, are pointed out. (auth)

11512 **Skeletal scanning in neoplastic disease.** O'Mara, R.E. (Univ. of Arizona College of Medicine, Tucson). *Cancer, Suppl.*; **37**: No. 1, 480-486(Jan 1976).

From ACS-NCI national conference on advances in cancer management. II. Detection and diagnosis; Denver, CO, USA (1 May 1975).

Bone imaging techniques are a sensitive and accurate method for the detection of primary and secondary neoplastic disease of the skeleton. Such procedures have been demonstrated to be superior to evaluation via blood chemistry levels or routine skeletal radiographic surveys. These techniques are also helpful in establishing sites for biopsy and for objective evaluation of therapeutic modalities. They suffer the disadvantage of being nonspecific, and as a result, all positive areas identified by scanning techniques should be correlated with radiographic changes. (auth)

11513 **Radionuclide identification of tumors.** Kaplan, W.D.; Adelstein, S.J. (Harvard Medical School, Boston). *Cancer, Suppl.*; **37**: No. 1, 487-495(Jan 1976).

From ACS-NCI national conference on advances in cancer management. II. Detection and diagnosis; Denver, CO, USA (1 May 1975).

Tumor-seeking radiopharmaceuticals have been employed in the diagnosis of primary neoplasms, in the detection of distant disease, particularly in the localization of tumor foci to facilitate biopsies and the planning of radiation portals, and in assessing the response to tumor therapy. At the present, there is no ideal tumor-scanning agent. However, several approaches appear to be useful and offer promise for further study. The greatest experience has been with ^{67}Ga, which has major utility in the staging of Hodgkin's disease, in the diagnosis of bronchogenic carcinoma, in the detection of certain metastatic brain tumors, in the identification of recurrent disease, and in the noninvasive diagnosis of leukemic complications. A number of radiolabeled antibiotic and chemotherapeutic agents have shown promise, including tetracycline and bleomycin. A major drawback, however, of these agents which is shared with ^{67}Ga is that they appear to be sequestered by inflammatory as well as neoplastic tissue. A most intriguing approach is the use of radiolabeled antibodies to tumor-associated antigens. Animal and clinical experiments have employed antifibrin, antifibrinogen, anticarcinoembryonic antigen, and antiferritin. Theoretically, agents such as these should allow for greater tumor specificity. (auth)

MICROBIOLOGY

REFER ALSO TO CITATION(S) 11522

11514 **Inducible error-prone repair in Escherichia coli.** Sedgwick, S.G. (Brookhaven National Lab., Upton, NY). *Proc. Natl. Acad. Sci. U.S.A.*; **72**: No. 7, 2753-2757(Jul 1975).

A hypothesis that ultraviolet-induced mutagenesis arises from the induction of an error-prone mode of postreplication repair that requires the $exrA^+$ $recA^+$ genotype has been tested with alkaline sucrose gradient centrifugation coupled with assays of fixation determined by loss of photoreversibility. The inhibitor of

protein synthesis, chloramphenicol, added before irradiation, prevented a small amount of postreplication repair and completely eliminated mutation fixation in E. coli WP2/sub s/ uvrA. However, chloramphenicol did not affect strand joining: (a) in uvrA bacteria allowed 20 min of growth between irradiation and antibiotic treatment; (b) in nonmutable uvrA exrA bacteria; and (c) in uvrA tif bacteria grown at 42° for 70 min before irradiation. These observations indicate that an inducible product is involved in a fraction of postreplication repair and is responsible for induced mutagenesis. (auth)

MORPHOLOGY

11515 (BNL—20812) **Practical problems in observation of unfixed, uncoated plant surfaces by SEM.** Ledbetter, M.C. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. 6p. (CONF-760406—2). Dep. NTIS $3.50.

From 9. annual scanning electron microscopy symposium; Toronto, Canada (6 Apr 1976).

The advantages of using fresh, unfixed, and uncoated plant specimens in the examination of surface configurations by SEM were realized several years ago. It is difficult to achieve equivalent structural fidelity by methods which involve chemical fixation and dehydration, even when great care is exercised and critical point drying is used. The frequency with which less faithful micrographs of fixed, dried, and coated plant specimens appear in botanical literature suggests that either the elegance of the method using fresh preparations is not fully appreciated or that many workers have found application of the technique too difficult for practical use with their specimens. The purpose of this paper is to explore the range of application and the limitations of the fresh tissue method, including simple techniques for preparation and use of fresh-frozen samples. (auth)

11516 (UCD—472-122, pp 130-131) **Scanning electron microscopy of primary bone tumors.** Pool, R.R.; Kerner, B. Jun 1975.

In Annual report, fiscal year 1975.

Critical-point-drying of tumor tissue fixed in a glutaraldehyde-paraformaldehyde solution and viewed by scanning electron microscopy (SEM) provides a 3-dimensional view of tumor cells and their matrices. This report describes the SEM appearance of three primary bone tumors: a canine osteosarcoma of the distal radius, a feline chondrosarcoma of the proximal tibia and a canine fibrosarcoma of the proximal humerus. The ultrastructural morphology is compared with the histologic appearance of each tumor. (auth)

PATHOLOGY

REFER ALSO TO CITATION(S) 11494

11517 (AAEC/E—340) **Synergic factors in murine nephrosis, demonstrated by computer techniques.** Tucker, A.D.; Ehmen, G.; Smith, H.E.; Barry, J.M.; Bills, J.W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jul 1975. 21p. Dep. NTIS (US Sales Only) $3.50.

Simple environmental changes, including a whole, fresh diet, delayed the onset of the usual diseases of lungs and kidneys in laboratory rats. Spontaneous nephrosis appears to develop from interactions involving inherent immune status, nurture, and environmental factors, particularly inhalants. These methods could be adapted to toxicological investigations and the results suggest the need for new approaches in statistical and interpretative analyses. (auth)

11518 Staging laparotomy in non-Hodgkin's lymphoma. Moran, E.M.; Ultmann, J.E.; Ferguson, D.J.; Hoffer, P.B.; Ranniger, K.; Rappaport, H. (Univ. of Chicago). *Br. J. Cancer;* **31**: 228-236(1975).

In 57 patients with non-Hodgkin's lymphoma, a clinical, radiographic scintigraphic and pathological correlative study showed the following results: (1) The inferior venacavagram, lymphangiogram and gallium-67 scan have a low sensitivity in detecting lymphoma: their accuracy is high when the findings are interpreted as abnormal (93 percent, 83 percent, and 80 percent respectively), but low when they are interpreted as normal (47 percent, 67 percent and 58 percent respectively); (2) the clinical evaluation of spleen and liver is unreliable; (3) the incidence of lymphocytic lymphoma in the para-aortic-iliac nodes is high; (4) a pattern of involvement by contiguity and a predilection for the spleen were observed in lymphocytic lymphoma; (5) in lymphocytic lymphoma there is no liver involvement without concomitant splenic involvement; (6) no definite pattern of spread could be seen in histiocytic lymphoma; (7) surgical staging changed the classification of the lymphoma in 56 percent of cases, 46 percent being reclassified to a more advanced stage; (8) surgical staging significantly improves the assessment of the stage of disease and therefore permits accurate treatment planning. (auth)

11519 Staging procedures in mycosis fungoides. Griem, M.L.; Moran, E.M.; Ferguson, D.J.; Mettler, F.A.; Griem, S.F. (Univ. of Chicago). *Br. J. Cancer;* **31**: 362-367(1975).

Mycosis fungoides (MF) in deep-seated lymph nodes, spleen or liver appears to be associated with a lack of response of the disease to topical external therapy. Fourteen patients with mycosis fungoides were clinically staged and had a staging laparotomy. Myosis fungoides was found in the lymph nodes of 3 of these patients, in the spleen in 4 and in the liver of 2 cases. Patients with adenopathy, or with splenomegaly or abnormal spleen scans, should be considered for surgical staging to determine the extent of extracutaneous disease. The documentation of extracutaneous MF becomes necessary in the development of new therapeutic approaches. (auth)

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 11502

11520 Allotransplantation of lung without immunosuppression after transplantation. I. Staged transplantation of bone marrow and lung. Blumenstock, D.A.; Kazemi, H.; Hales, C.A.; Cannon, F.D.; Zumwalt, R.; Ferrebee, J. (Mary Imogene Bassett Hospital, Cooperstown, NY). *Transplantation;* **18**: No. 4, 336-342(Oct 1974).

Six of 12 animals are alive 8 to 22 months after transplantation. Five of these animals and one which died of streptococcal pneumonia after pulmonary function testing demonstrated adequate pulmonary function in the transplant. One living recipient has not been studied. Four animals died of a "wasting syndrome" thought to be related to radiation damage to the pancreas rather than graft-versus-host reaction. One animal was killed with a severe skin eruption of unknown cause. (auth)

11521 Action of valinomycin in uncoupling corn mitochondria. Hensley, J.R.; Hanson, J.B. (Univ. of Illinois, Urbana). *Plant Physiol.;* **56**: 13-18(1975).

Valinomycin in the presence of potassium is a potent uncoupler of corn (Zea mays L.) mitochondria, eliminating respiratory control. Valinomycin produces higher steady state potassium phosphate swelling which can be reversed to give active shrinkage if mersalyl is added to block the Pi^-/OH^- antiporter. Respiration declines concurrently. Uncouplers accelerate the shrinkage and restore the respiration. The same results can be obtained with sodium phosphate if gramicidin D is substituted as ionophore. It is concluded that valinomycin uncoupling is the result of cyclic salt transport, with influx pumping of potassium phosphate via the Pi^-/OH^- antiporter and efflux pumping via a K^+/H^+ antiporter. The result is a higher level of steady state swelling, rapid turnover of the proton gradient, and uncoupled respiration rates. The level of steady state swelling can be manipulated by varying the valinomycin or K^+ concentrations, with high concentrations favoring activation of the efflux pump. A mosaic membrane model with high resistance for proton and monovalent cation penetration to the $cation^+/H^+$ antiporter is used to explain the results. (auth)

PUBLIC HEALTH

REFER ALSO TO CITATION(S) 11506

11522 Method for detection of trichinellae. Giles, P.M. (to U.S. Energy Research and Development Administration). US Patent 3,918,818. 11 Nov 1975. Filed date 29 Mar 1974. 2p.

PAT-APPL-456,391.

A process for rapid detection of trichinellae in samples of meat by compressing the said sample by means of a simple mechanical or hand press in a solution of glycerol or ethylene glycol, mounting the compressed sample between glass plates, and projecting this sample onto a standard projection screen. 4 claims, 1 drawing figure.

AGRICULTURE AND FOOD TECHNOLOGY

11523 (LA—6110-PR) **Probe activities. Annual report, July 1, 1974—June 30, 1975.** Holm, D.; Sanders, W.M.; Payne, R.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-Eng-36. 11p. Dep. NTIS $4.50.

Numerous small-scale experiments and feasibility studies were performed for the U.S. Department of Agriculture. Subjects include a telemetry system for remote continuous temperature monitoring, irradiation of biological materials, process monitoring of canned foods, and experiments associated with the screwworm fly eradication program. (auth)

TRACER TECHNIQUES

11524 (STI/PUB—419) **Tracer techniques for plant breeding. Panel proceedings series. Proceedings of a conference held in Vienna, 2—6 December 1974.** (International Atomic Energy Agency, Vienna (Austria)). 1975. 120p. (CONF-741261—). IAEA $7.00.

From Proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974).

Separate abstracts were prepared for the 12 papers presented at the conference. (HLW)

11525 **Need for better selection techniques: a plant breeder's view.** Haensel, A. (Probstdorfer Saatzucht GmbH, Vienna). pp 3-7 of In Tracer techniques for plant breeding. Vienna; International Atomic Energy Agency (1975).

From Proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974).

See STI/PUB—419; CONF-741261—.

The main breeding aims are described, and a theoretical consideration of possible combinations of heritability and of correlation to yield of any plant character is presented. The ideal type of character required by the plant breeder in selecting for yield and/or quality is listed, together with subjects on which the plant breeder requires more information. (auth)

11526 **Need and prospects for using tracer techniques in fruit breeding.** Zagaja, S.W. (Research Inst. of Pomology, Skiemiewice, Poland). pp 9-12 of In Tracer techniques for plant breeding. Vienna; International Atomic Energy Agency (1975).

From Proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974).

See STI/PUB—419; CONF-741261—.

Compared with staple food crops and fodder crops, the commercial value of fruits depends more on their quality than on their productivity. Modified screening techniques are therefore required for fruit crop improvement. The following are areas of fruit crop improvement in which tracer techniques could be used to speed up the progress: assessment of rootstocks and particularly their effect on vigour of growth and productivity of the trees; assessment of mutants productivity; assessment of adaptability to various habitats of fruit tree cultivars and rootstocks; and juvenility studies on fruit trees, aimed at shortening the juvenile stage. On each of these subjects background information is provided and suggestions are made concerning the scope of research. (auth)

11527 **Use of isotopes to explore the physiology and biochemistry of photorespiration and its effects on crop yields.** Keys, A.J.; Bird, I.F.; Cornelius, M.J.; Kumarasinghe, S.; Whittingham, C.P. (Rothamsted Experimental Station, Harpenden, Eng.). pp 13-18 of In Tracer techniques for plant breeding. Vienna; International Atomic Energy Agency (1975).

From Proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974).

See STI/PUB—419; CONF-741261—.

Crop yield depends on the rates of photosynthesis, transport of assimilate, growth of useful parts of the plant, photorespiration and dark respiration. Photorespiration is closely associated with photosynthesis; it probably has a direct effect on photosynthetic efficiency and causes a loss of recently assimilated carbon as CO_2. Photorespiration is, however, associated with phosphorylation of ADP to ATP in mitochondria and results in transport of carbon out of the chloroplast. Serine, a major product of photorespiration, is readily converted to sucrose in leaves. Using [^{14}C] serine it was shown that sucrose synthesis from serine required concurrent photosynthetic assimilation of CO_2 and aerobic conditions. This suggests sucrose synthesis from serine may be dependent upon continuing photorespiration for energy and may not directly involve metabolism in the chloroplast. In wheat leaves, much if not all the carbon assimilated in air may be metabolized by the photorespiratory pathway (glycollate pathway). This was shown by rates of change of ^{14}C in intermediates when conditions were changed suddenly from steady photosynthesis in the presence of $^{14}CO_2$. On the other hand, intramolecular labelling of sucrose, following short periods of photosynthesis in $^{14}CO_2$, was not entirely consistent with all sucrose being made from intermediates of the glycollate pathway, even in air containing 150 v. p. m. $^{14}CO_2$. (auth)

11528 **Enzymes in biogenesis of plant cell wall polysaccharides: enzyme characterization using tracer techniques.** Dickinson, D.B. (State Univ. of New York, Buffalo). pp 19-24 of In Tracer techniques for plant breeding. Vienna; International Atomic Energy Agency (1975).

From Proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974).

See STI/PUB—419; CONF-741261—.

Tracers are indispensable in the study of plant enzymes. Labelled compounds are employed in routine enzyme assays and in studies of the kinetic and regulatory properties of enzymes. The advantages of radiochemical enzyme assays include their great sensitivity and specificity. These permit assays of crude plant extracts, often in the presence of inhibitors of contaminating enzymes that would interfere with a less sensitive type of assay. Potential disadvantages of radiochemical assays are the time and effort needed to separate labelled product from labelled substrate, particularly if solubility properties or net electrical charges of these compounds are not sufficiently different to permit rapid separation by solvent extraction or ion-exchange chromatography. Isotope effects are seldom a problem for biologists. Our research deals with enzymes and metabolic pathways by which starch and cell wall polysaccharides are formed. The goal is to learn how these processes are regulated and particularly to identify the enzymatic regulatory mechanisms involved. Germinating lily pollen is used for studies of cell wall formation; both pollen and maize endosperm are used for studies of starch biosynthesis. Hexokinase is the first step in conversion of hexoses to starch, wall polysaccharides and respiratory substrates. The maize endosperm enzyme was assayed by its conversion of ^{14}C-hexose to ^{14}C-hexose-6-P, and rapid separation of the two labelled compounds on anion-exchange paper. (auth)

11529 **Some nuclear techniques applicable for physiological characterization of plant material.** Antoszewski, R. (Research Inst. of Pomology, Skiemiewice, Poland). pp 25-30 of In Tracer techniques for plant breeding. Vienna; International Atomic Energy Agency (1975).

From Proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974).

See STI/PUB—419; CONF-741261—.

The following nuclear techniques and apparatus based on application of radioactive isotopes are described: a laboratory set-up for studying minute changes in water content of intact plants based on beta-ray absorption emitted by ^{14}C; a field apparatus for studying the water balance in leaves of intact plants under field conditions based on the same principle; a laboratory set-up for measuring the water balance in fruit based on beta-ray penetration emitted by ^{32}P; and a modified Shimshi apparatus. The idea of so called "transport economy" in a plant system is introduced, and some methods of measuring it are proposed. (auth)

11530 **Tracer techniques in plant breeding programmes.** Lupton, F.G.H. (Plant Breeding Inst., Cambridge, Eng.). pp 31-42 of In Tracer techniques for plant breeding. Vienna; International Atomic Energy Agency (1975).

From Proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974).

See STI/PUB—419; CONF-741261—.

Tracer techniques may be used as a tool in plant breeding programs either to help in the choice of parental combinations with complementary advantages or in the selection of desirable plants within the segregating populations. The second application is, however, of little practical application as the techniques involved are mostly too tedious to be used on the large populations with which the plant breeder must deal and frequently involve unacceptable destructive sampling of his material. The physiological analysis of potential parents is of considerable importance, particularly in the improvement of crops to be grown in more fully developed countries with advanced agricultural systems. Techniques using radioactive tracers and radiation-emitting sources such as the neutron probe have played a considerable part in this work. They have been used by cereal breeders to measure photosynthesis either of individual leaves, or of undisturbed crop canopies, and by breeders of many crops in the study of the translocation of the products of photosynthesis within the plant. They have also been used in studies of the effects of plant diseases on translocation patterns, thus identifying limiting factors for which the breeder should select. Radioactive tracers have also been used in estimating varietal differences in root growth and distribution, but the results obtained from such experiments have indicated that environmental differences are greater than those between geno-

types. Differences in water uptake have, however, been demonstrated using the neutron probe, though these differences appear to be much influenced by differences in the water economy of the aerial parts. (auth)

11531 Use of tracer techniques to study yield components in seed crops. Stoy, V. (Swedish Seed Association, Svalov). pp 43-55 of In Tracer techniques for plant breeding. Vienna; International Atomic Energy Agency (1975).

From Proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974).

See STI/PUB—419; CONF-741261—.

High yield is a main objective in most plant breeding programs and, therefore, a thorough knowledge of the physiological determinants of yield as well as their mode of inheritance ought to be of great value to the breeder. Ideally it should enable him both to select suitable parents for his crossing programs and to screen the offspring from these crosses (as also from treatments with mutagenic agents) for desirable agronomic characters. The production of seeds depends on the magnitude of total dry matter production as well as on the efficiency of transfer of the substances produced to the developing seeds. Both these processes can conveniently be studied with the aid of isotopic tracers. The course of this assimilate translocation and the efficiency of the partitioning system can also be determined very conveniently by using appropriate isotopes. Moreover, pulse labelling at different stages of development and subsequent sequential harvesting make it possible for the investigator to follow the dynamic pattern of assimilate movement and also to describe it in quantitative terms. With the aid of tracers it is often easy to determine which substances are primarily formed during the fixation process, which compounds make the transport forms, and which storage products the translocated compounds finally are incorporated into. It is also possible to elucidate the pathways of biosynthesis of various economically important components of the seeds with methods utilizing the advantages of tracers. Finally it should be pointed out that the movement of assimilates in plants obviously is under hormonal control, and that valuable information about the influence of different hormones and growth regulators on the distribution of labelled assimilates can be obtained in properly designed experiments. This information may subsequently be used both for the external application of growth regulators and for the breeding of crop plants with desired morphological characters. (auth)

11532 Physiological selection criteria in forage grasses. Cooper, J.P. (Welsh Plant Breeding Station, Aberystwyth). pp 65-71 of In Tracer techniques for plant breeding. Vienna; International Atomic Energy Agency (1975).

From Proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974).

See STI/PUB—419; CONF-741261—.

The plant breeder has to develop varieties that provide the most efficient conversion of environmental inputs and have sufficient resistance to environmental stress. The most important physiological features that determine crop production and for which the plant breeder will have to select are discussed. Tracer studies may be of help to the breeder at the investigational level but in the longer term may also provide direct screening techniques for certain of the important physiological characteristics. (auth)

11533 Tracer techniques for the study of host-parasite relations. Mendgen, K. (Univ., Goettingen, Ger.). pp 73-77 of In Tracer techniques for plant breeding. Vienna; International Atomic Energy Agency (1975).

From Proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974).

See STI/PUB—419; CONF-741261—.

Autoradiographic techniques were used to study the interactions of many facultative and obligate parasites, including viruses. After feeding the host plant with labelled substrates, labelled material accumulates in the infected cells and seems to penetrate into structures of the parasite. After labelling the parasite, its influence on the host may be studied. We use this technique to study the interaction of host (bean) and parasite (bean rust) during the infection process. After infection with uredospores labelled with tritiated orotic acid, the radioactivity is retained almost completely within the young haustorium at 22 h after inoculation. This may indicate a very small influence of the parasite on its compatible host. In incompatible host-parasite combinations, the infection process proceeds in a different way. The use of autoradiographic techniques to compare combinations of varying compatibilities will be discussed. (auth)

11534 Nuclear techniques for determining biomass production, evaporation and transpiration, root development, and nutritional value. Niemann, E.G.; Kuehn, W.; Kaul, A.K. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Hanover). pp 79-83 of In Tracer techniques for plant breeding. Vienna; International Atomic Energy Agency (1975).

From Proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974).

See STI/PUB—419; CONF-741261—.

Some nuclear methods are presented which could be of assistance to the plant breeders in selecting for positive plant characters. Several methods have been developed for the continuous determination of biomass by means of gamma-absorption measurements in single plants as well as in experimental field plots. The response of plant growth to environmental conditions such as fertilization, irrigation, and day length, dependent on genetic parameters can easily be followed by these techniques. Primarily for the investigation of water vapour movement in soils and between soil and atmosphere under conditions of temperature inversions, a technique has been worked out using ^{3}H-labelled water and water vapour. The inclusion of plants in this system will allow the determination of water balance under varying environmental conditions. An autoradiographic method has been applied using ^{86}Rb as trace element mainly for the measurement of root distribution of trees (apple, coffee). Finally, a sequence of analytical steps is described that has been developed and used in Hanover for the selection for protein amount and quality in crop plants. Though not all of these steps include nuclear methods, the application of tracer techniques in this and other screening sequences is an invaluable help for breeders and analysts. (auth)

11535 Method using aminoacylation and transfer ribonucleic acid (tRNA) from wheat embryo and isotope dilution for screening of genotypes with improved protein content and quality. Denic, M. (Inst. for the Application of Nuclear Energy in Agriculture, Veterinary Medicine and Forestry, Zemun, Yugoslavia). pp 85-94 of In Tracer techniques for plant breeding. Vienna; International Atomic Energy Agency (1975).

From Proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974).

See STI/PUB—419; CONF-741261—.

The possibilities for screening protein quality in crop plants are considered with special attention given to the determination of limiting amino acids. Conditions for determining lysine and methionine are presented. Because of the high specificity of transfer ribonucleic acid to bind its corresponding amino acid, in principle, it is possible to determine any amino acid that is incorporated into protein. The method is both specific and sensitive. Since it is also rapid and relatively inexpensive, it is useful in studies on breeding for improved protein quality. (auth)

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS

11536 (UCD—472-122, pp 165-167) **Some speculations on the role of radiation quality on "injury" and tumor risk from bone-seeking radionuclides.** Goldman, M.; Rosenblatt, L.S. Jun 1975.

In Annual report, fiscal year 1975.

Relative effectiveness of three bone-seeking radionuclides in beagles following intravenous injection are quantified in terms of initial (less than 1 year) marrow "injury" (neutropenia) and late effects (osteosarcoma incidence). The non-linear dose-response curves for both end points were fit to a probit model and at lower doses, producing the same degree of initial neutropenia, relative tumor incidences for ^{90}Sr, ^{226}Ra, and ^{239}Pu were 1, 10, and 100, respectively. (auth)

RADIATION EFFECTS ON BIOCHEMICALS

IN VITRO

REFER ALSO TO CITATION(S) 11186

11537 ESR study of the anion radicals of 5-nitropyrimidines: conversion to iminoxy radicals. Sevilla, M.D.; Clark, C.; Failor, R. (Oakland Univ., Rochester, MI). *Radiat. Res.;* **65**: No. 1, 29-40(Jan 1976).

The anion radicals of a number of 5-nitropyrimidines have been investigated by ESR spectroscopy. The anions are formed by

electrolysis in dimethylformamide and by electron attachment in aqueous glasses, 12 M LiCl—D_2O and 8 M NaOD. The electrolysis of 5-nitrouracil and 5-nitro-6-methyluracil results in relatively stable anion radicals. The results for 5-nitrouracil give evidence for two or perhaps three anions which differ only by the degree of ring nitrogen protonation. The results for 5-nitro-6-methyluracil suggest that the nitro group of the anion is twisted so that it is coupled only weakly to the ring π-electron system. The anions of 5-nitrouracil, 5-nitroorotic acid, 5-nitrobarbituric acid, and 5-nitro-6-methyluracil have been produced in the alkaline and neutral aqueous glasses. The anisotropic spectra found have been analyzed with the aid of computer simulations which assume axial symmetry. For example, the analysis of the spectrum of 5-nitrouracil anion in 12 M LiCl yields A/sub parallel//sup N/ = 33; A/sub perpendicular to//sup N/ = 5, a_o/sup H/ = 5.5 G, g/sub parallel/ = 2.0016, and g/sub perpendicular to/ = 2.0059. A concentration dependence in the splittings is noted and discussed. Ultraviolet photolysis of the anions of 5-nitro-6-methyluracil and 5-nitrobarbituric acid results in the formation of iminoxy radicals. Mechanisms of formation of the iminoxy radicals are discussed and results found in this work are compared to results found in single crystals and aqueous solution. (auth)

IN MICROORGANISMS

11538 (COO—2448-2) **Characterization of ionizing radiation damage in DNA. Progress report, May 1, 1975—April 30, 1976.** Hawkins, R.B. (Saint Louis Univ., Mo. (USA). School of Medicine). 1976. Contract E(11-1)-2448. 30p. Dep. NTIS $4.00.

The objective of this research is the characterization and quantitative assay of ionizing radiation-induced damage in DNA and nucleoprotein. Two lines of investigation have been pursued. The first is aimed at detection and assay of DNA to protein covalent cross linkage in coliphage T7. Protein and DNA are labeled with ^{14}C and ^{32}P, respectively. Cross linkage is assessed from the amount of labeled protein distributing like DNA and labeled DNA distributing like protein on a phenol-water countercurrent distribution system. It has been found that damage involving cross linkage occurs by two modes of radiation action in phage irradiated with ^{60}Co γ rays in .001M histidine medium. Indirect effects play a large role in one mode and direct effects play a large role in the other. In the second line of investigation, the hydrodynamic and viscoelastic properties of DNA from irradiated phage and cells will be examined to determine the extent to which DNA to DNA cross linkage and points of altered flexibility are introduced by radiation. An instrument for viscoelastic measurements has been constructed in preparation for these studies. (auth)

IN ANIMALS

REFER ALSO TO CITATION(S) 11539

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

11539 (ORO—4761-4) **Repetitious nature of repaired DNA in mammalian cells. Progress report, June 1, 1975—May 31, 1976.** Meltz, M.L. (Southwest Foundation for Research and Education, San Antonio, Tex. (USA)). 1976. Contract AT(40-1)-4761. 77p. Dep. NTIS $5.00.

The specific activity of DNA isolated from cultured mammalian cells labeled with tritiated thymidine was determined for 20 minute intervals beginning at different times post-uv irradiation, during the period in which post-replication repair is presumed to occur. It was concluded that the radioactivity incorporated into the DNA synthesized at different times post-uv irradiation, during the period of presumed post-replication repair, is uniformly distributed throughout the genome. (auth)

11540 **Relationships among repair, cancer, and genetic deficiency: overview.** Setlow, R.B. (Oak Ridge National Lab., TN). pp 711-717 of In Molecular mechanisms for repair of DNA, Part B. Hanawalt, P.C. (ed.). New York; Plenum Publishing Corp. ([nd]).

The following conclusions are drawn: many different types of damage to DNA may be repaired; a number of completely different types of damage to DNA may be repaired; chemical and physical carcinogens damage DNA, as indicated by direct observation and by the fact that they provoke the sequence of repair steps in DNA; and the use of xeroderma pigmentosum cells—the analogue of excision-deficient bacterial cells—emphasizes the utility of investigating the effects of chemical carcinogens on human cells. (auth)

11541 (LA-tr—74-3) **Cell cycle analyses with a pulse cytophotometer: the effect of chemical and physical noxae on the kinetics of the proliferation of tumor cells.** Goehde, W. (Muenster Univ. (F.R. Germany). Inst. fuer Strahlenbiologie). 1974. Translation of a German report. 122p. Dep. NTIS $5.50.

Thesis.

The following studies were conducted on Ehrlich ascites tumor cells using the pulse cytophotometer: rate of DNA synthesis during the S phase; the effect of cytostatic drugs, endoxan, bleomycin, and other antibiotics on cell kinetics; and effects of x radiation and 1 to 6 MeV neutrons on cell kinetics. (HLW)

11542 **Use of track-end alpha particles from ^{241}Am to study radiosensitive sites in CHO cells.** Datta, R.; Cole, A.; Robinson, S. (Univ. of Texas System Cancer Center, Houston). *Radiat. Res.;* 65: No. 1, 139-151(Jan 1976).

Monolayers of CHO cells placed on membrane filters were irradiated with alpha particles from a ^{241}Am source. Particle penetration into the cells was controlled by placing the cell sample at various distances from the source. Dosimetric and spectrometric measurements were performed at comparable positions using a parallel plate ionization chamber and a scintillation crystal spectrometer. Cell survival, as measured by conventional cloning techniques, was single hit in form. A pronounced minimum in mean lethal dose of 29 rad was observed for alpha particle beams that penetrated only about 3 μm into the cell. A pronounced maximum in inactivation cross section of 90 μm^2, equal to about half the projected area of the nucleus, occurred for beams that penetrated only 5 to 7 μm into the cell. Thus, a single alpha particle penetration several micrometers within the cell nucleus was effective in killing the cell, while fully penetrating beams were actually less efficient; the latter beams required multiple particle traversals and about three times the cell dose to achieve the same effect. These results support the proposal that radiosensitive sites are located in a thin peripheral region of the nucleus. (auth)

11543 **RBE as a function of neutron energy. II. Statistical analysis.** Kellerer, A.M.; Hall, E.J.; Rossi, H.H.; Teedla, P. (Columbia Univ., New York). *Radiat. Res.;* 65: No. 1, 172-186(Jan 1976).

An experimental study of the relative biological effectiveness of neutrons of various energies for the inactivation of hamster cells has been reported previously; the present article contains a detailed statistical analysis of the data. Repeated determination of X-ray survival curves made it possible to assess the statistical fluctuations of survival rates. Within individual experiments the statistical variations are close to those expected on theoretical grounds. However, between experiments substantial variations in the reaction to X rays occur; these fluctuations can be approximately described by dose-modifying factors. An idealized survival curve for X-irradiation has been derived. The survival curves for neutrons have been compared to the linear—quadratic dose—effect relation and the two coefficients in this equation have been derived together with their joined confidence regions. The linear coefficient for neutrons reaches a maximum for neutron energies of several hundred thousand electron volts; the coefficient of the quadratic component is increased at neutron energies below 1 MeV. The dependence of RBE on neutron energy and on neutron dose is derived from the estimated dose—effect relations. In addition the more rigorous nonparametric method is used to derive confidence intervals for the RBE of neutrons. (auth)

11544 **Human cell survival as a function of depth for a high-energy neon ion beam.** Raju, M.R. (Los Alamos Scientific Lab., NM); Blakely, E.; Howard, J.; Lyman, J.T.; Kalofonos, D.P.; Martins, B.; Yang, C.H. *Radiat. Res.;* 65: No. 1, 191-194(Jan 1976).

Cultured human kidney cells were irradiated while suspended in a gelatin cylinder using a 400-MeV/u neon ion beam produced by the Berkeley BEVALAC. The Bragg peak was transformed to a width of 4 cm with a ridge filter, and cell survival (colony-forming ability) was determined as a function of depth and dose. A cell survival curve in the broadened peak region appeared to be exponential, and RBE values in the peak and plateau regions were approximately 3.0 and 1.8, respectively, at the 10 percent survival level. Thus, the results indicate that the biological effect is enhanced even when the narrow peak is broadened. The secondary particles (ions lighter than neon and neutrons) produced by neon ions do not cause much cell killing beyond the range of neon ions and, thus, do not seem to be a limiting factor for the use of neon ion beam in radiotherapy.(auth)

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

11545 (SAND—75-0168) **Inactivation of bacteria in sewage sludge by ionizing radiation, heat, and thermoradiation.** Brandon, J.R.; Langley, S.L. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 43p. Dep. NTIS $5.00.

For purposes of animal feeding or fertilizer usage on edible crops, sewage sludge must be free of pathogenic organisms. Bacterial inactivation by a combination of heat and irradiation is shown to be effective. These results must be viewed in conjunction with those from studies of parasite egg inactivation, virus inactivation, and physical-chemical benefits in order to make a fair assessment of the value of the thermoradiation treatment compared to other possible sludge treatment processes. (auth)

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 10302

11546 (AD/A—005898) **The effect of extremely low frequency radiation on human performance: a preliminary study. Medical research progress report.** Gibson, R.S.; Moroney, W.F. (Naval Aerospace Medical Inst., Pensacola, Fla. (USA)). Aug 1974. 24p. (NAMRL—1195). NTIS $3.25.

Interest in the development of an extremely low frequency (ELF) communications system for naval use has resulted in a program to determine the effects of such fields on man. This report represents part of pilot level effort to develop a set of tests and procedures for determining whether ELF fields have any measurable effects on human memory and psychomotor functions. None of the tests exhibited significant performance decrements under the gross analytical conditions. The Wilkinson Adding Task exhibited significant performance decrements during the second of two testing sessions while being exposed to the ELF radiation. One of the Response Analysis Tester (RATER) conditions exhibited a significant improvement in performance. One subject had a significantly bad session in which his performance declined on 6 out of 7 measures; however, this performance appeared to be unrelated to other psychological or physiological data. In view of the large number of statistical analyses performed on a limited amount of data, the few significant performance decrements must be interpreted with extreme caution. They identify techniques to be replicated in future research and nothing more. Individual differences in test performance were large, any effects due to the exposure to ELF magnetic fields were small; consequently, special consideration should be given to the possibility of using an exposure-reexposure experimental design in any future experiments. (GRA)

11547 (AED-CONF—74-725-000(vol.2), pp 736-764) **Problems and attempts at their solution in the statistical planning and evaluation of epidemiological studies.** Lange, H.J.; Neiss, A. 1974. (In German).

From Annual meeting of the Fachverband fuer Strahlenschutz e.V. in cooperation with the Vereinigung Deutscher Strahlenschutzaerzte e.V.; Helgoland, F.R. Germany (23 Sep 1974).

9 figs.; 12 refs. Available from ZAED.

In Radiation protection and environmental protection. Vol. 2.

The problems connected with the statistical planning and evaluation of studies on the correlation between a number of factors and the incidence of a certain chronic disease are pointed out. In particular, multivariate mathematical models for the evaluation of longitudinal section studies are discussed which enable a quantitative determination of this correlation to be made. Furthermore, the influences of different factors appearing simultaneously can be correlated with each other using the methods described above. (DE)

11548 (CONF-740930—, pp 120-124) **Cytogenetic determination of the effect of irradiation on in vitro lymphocyte transformation rates.** Lloyd, D.C.; Dolphin, G.W.; Purrott, R.J. (National Radiological Protection Board, Harwell, Eng.). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

The effect of x irradiation on the yield of transformed cells in 48-hr cultures has been studied in human peripheral-blood lymphocytes. Cytogenetic damage was used as a marker, aberration yields being obtained for mixed cultures prepared from equal numbers of normal and irradiated lymphocytes and from pure cultures of irradiated cells. Comparison of data from these two types of culture shows that the yield observed ranged from 90 percent of that expected at 50 rads to 11 percent at 700 rads. Poisson analysis demonstrated that for all doses, cells with high levels of structural damage were not selectively eliminated. The extent to which mitotic delay contributes to the reduction in numbers of transformed cells was examined by varying the time in cultures from 36 to 72 hr. The implication of this work in the field of radiation-dose estimation by chromosome-aberration analysis is discussed. (auth)

11549 (CONF-740930—, pp 125-139) **Survival of human lymphocytes after exposure to densely ionizing radiations.** Madhvanath, U.; Raju, M.R.; Kelly, L.S. (Univ. of California, Berkeley). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

Interphase death of human blood lymphocytes cultured in vitro was studied after exposure to ^{60}Co gamma rays and to accelerated ions of ^{1}H, ^{4}He, ^{7}Li, ^{11}B, ^{12}C, ^{20}Ne, ^{40}Ar, and π^- meson beam under aerobic conditions. Exposures were also conducted under hypoxic conditions with ^{60}Co gamma rays, ^{4}He, ^{7}Li, and ^{12}C ion beams. Time course of interphase death was followed for 6 days after irradiation. Percent survivals were determined by using the trypan blue exclusion method. Survival curves at 5 days postirradiation were exponential for all radiations studied. These observations indicate that the production of interphase death of lymphocytes by densely ionizing radiations follows a pattern similar to that observed with colony-forming mammalian cells. However, the reproductive capacity of the latter cells is impaired with maximum effectiveness at energy densities associated with 220 keV/μm for the beam conditions used in this investigation. The much lower energy densities required to kill a lymphocyte suggest that a sensitive structure other than DNA may be responsible for the production of lymphocyte death, perhaps the membranes. The calculated inactivation cross sections for high-LET radiations above 650 keV/μm yielded values larger than the actual cell dimensions. It appears that contributions from delta rays become appreciable in this system at these LET's. (auth)

11550 (CONF-740930—, pp 140-143) **Effect of postirradiation anoxia on radiosensitivity of lymphocytes.** Schrek, R. (Veterans Administration Hospital, Hines, IL). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

Radiosensitivity was measured by viable-lymphocyte counts and by uridine uptake. The viability of the lymphocytes was based on morphologic characteristics visualized by phase contrast microscopy of the cells in a special slide chamber. Low doses of x rays (10 to 1000 R) and incubation at 37°C killed lymphocytes in interphase with the production of pyknotic nuclei (nuclear death), and large doses (6000 R) produced nuclei with clear nucleoplasm (cytoplasmic death). Nuclear, but not cytoplasmic, death was inhibited by incubation of the irradiated cells at 27°C. Postirradiation anoxia had no effect on development of the nuclear and cytoplasmic death of lymphocytes irradiated with 100 to 6000 R. Anoxia had no effect on the early response of lymphocytes to phytohemagglutinin (PHA) [increase in ribonucleic acid (RNA) and protein synthesis] but inhibited completely the late effects [increase in deoxyribonucleic acid (DNA) synthesis and transformation into lymphoblastoid cells]. The PHA caused relative radioresistance of lymphocytes under aerobic conditions and, to a lesser extent, under anaerobic conditions. The slight radioresistance induced by PHA in anoxic lymphocytes apparently did not depend on an increase in DNA synthesis or on the transformation to lymphoblastoid cells. (auth)

11551 (CONF-740930—, pp 185-191) **Role of indirect radiation effects on cell membranes in the immune response.** Sternglass, E.J. (Univ. of Pittsburgh). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

Recent work by Petkau indicates that, in sharp contrast to the case of damage to the genes, the doubling dose for indirect radiation damage to cell membranes decreases as the dose rate declines, apparently as the result of a free-radical-mediated oxidative reaction involving O_2^-. These findings explain the earlier results of Stokke, who observed significant declines in bone-marrow cellularity of the hematopoietic stem cells involved in the immune processes at dose rates below 10^{-4} rad/min for total doses of only 0.1 to 2000 mrads, the doubling dose declining with total dose administered over periods of 6 to 18 weeks in a manner similar to that observed by Petkau. These observations, further-

more, explain the fact that erythrocyte permeability to monovalent cations can be significantly increased in occupationally exposed individuals at total doses of only 10 to 30 mR in 1 month, whereas thousands of rads are required at therapeutic dose rates. Evidence is presented suggesting the dominance of indirect, free-radical-mediated radiation effects over direct somatic mutation effects at background radiation rates on the development of cancer, leukemia, and infectious diseases from small radiation exposures encountered in the environment. The implications or the relative biological effect on the immune system of radiation at high and low dose rates are discussed. (auth)

11552 (DPSPU—75-30-12) **Emergency response planning at the Savannah River Plant.** Cooley, R.C. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Plant). Dec 1975. Contract AT(07-2)-1. 7p. (CONF-760202—30). Dep. NTIS $3.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Emergency response planning at the Savannah River Plant is a key factor in ensuring the safeguarding of personnel on the 200,000-acre plant site and in nearby communities. Planning has been continually upgraded since plant startup in the early 1950's. Detailed emergency response procedures for each plant area and major work group provide the foundation for proper response. Emergency response efforts are coordinated through an Emergency Operating Center (EOC). This facility contains life support equipment for isolation of personnel against hostile environments and extensive communications equipment. Preparations are being made to provide a computerized meteorological system in the EOC that provides real-time estimates of downwind hazards from credible accidents. Trained emergency response crews are available on-plant 24 hours per day to staff the EOC and coordinate activities. Key management personnel also report to the EOC when it is activated. Unannounced exercises are conducted periodically to test response readiness. (auth)

11553 (IRS-W—17(11-75)) **Compilation of data concerning population distribution near the site of nuclear installations in the Federal Republic of Germany.** Gutschmidt, W.D. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F.R. Germany)). Nov 1975. 103p. (In German). Dep. NTIS (US Sales Only) $5.50.

The report is a compilation of relevant data concerning population distribution near the site of nuclear installations in the Federal Republic of Germany. A classification of German nuclear sites in respect to population distribution is presented. In addition, German and US nuclear sites are compared by use of the site population factor. (auth)

11554 (ORNL/TM—5138) **Survey of radiation doses received by atomic-bomb survivors residing in the United States.** Kerr, G.D.; Yamada, H.; Marks, S. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 26p. Dep. NTIS $5.00.

A survey has been completed of 300 of an estimated 500 to 750 survivors of the atomic bombings in Hiroshima and Nagasaki who reside in the United States. Distributions with respect to age, sex, citizenship status, distance from the hypocenter at the time of bombing, and dose from immediate weapon radiation have been tabulated from the results and are presented for this group of 300 survivors. Also presented are survey results concerning exposures to residual radiation from fallout and neutron-induced radioactivity in the areas adjacent to the hypocenter. (auth)

11555 (TID—26953) **Second annual report of cancer research at the University of Chicago, 1974—1975.** Slatkin, S.P. (comp.). (Chicago Univ., Ill. (USA)). 1975. 257p. Dep. NTIS $9.00.

Brief summaries are presented of research projects in the following areas: virology, cell biology, tumor immunology, carcinogenesis, clinical research, radiotherapy, radiation physics, nuclear medicine, and care facilities. Descriptions are given of the cancer control center, the clinical cancer training program, and tumor clinics. Cancer-related conferences held at the University of Chicago during the period June, 1974 to June, 1975, are listed. (HLW)

11556 Autopsy techniques for recognition of radiation injury. Warren, S. (Cancer Research Inst., Boston). *Bull. Soc. Pharmacol. Environ. Pathol.*; 3: No. 2, vp(Jun 1975).

Methods of recognizing accidental or criminal radiation exposures through the detection of radiation injuries at autopsy are discussed. The various procedures available for use in suspected cases of exposure are briefly discussed. (ERB)

11557 (ERDA-tr—109) **Radiation safety in operating nuclear power stations.** Burnazyan, A.I. Translated by W.J. Grimes from *At. Energ. (USSR)*; 39: No. 3, 167-172(Sep 1975). 11p. Dep. NTIS $3.50.

Procedures for the radiation protection of personnel of a nuclear power plant during normal operation and in the event of a radiation accident are discussed. The protection of human populations in the plant vicinity is also considered. (CH)

11558 Effects of gonadal irradiation in clinical radiation therapy: a review. Lushbaugh, C.C. (Oak Ridge Associated Universities, TN); Casarett, G.W. *Cancer, Suppl.*; 37: No. 2, 1111-1120(Feb 1976).

From National Cancer Institute conference on delayed consequences of cancer therapy: proven and potential; Orlando, FL, USA (9 Jan 1975).

Recent improvements in radiation therapy of some malignancies in lower abdominal sites are leading to prolongation of life in persons of child-bearing age. These successes require an evaluation of the possible undesirable consequences of the unavoidable gonadal irradiation that occurs in these cases. A review of radiobiological data from experimental animal studies and retrospective clinical studies suggests that in most instances human gonadal exposures in both sexes are insufficient to cause permanent sterility, because the exposures are fractionated and the total gonadal dose is much less than 600 rads. As a consequence, return of fertility must be anticipated, and the worrisome questions of radiation-induced genetic damage in subsequent pregnancies must be addressed. This review did not substantiate this fear, because no case reports could be found of malformed infants among the progency of previously irradiated parents. Some experimental studies suggest that radiation-damaged spermatogonia are self-destructive, but any evidence for this phenomenon in the ovary is nonexistent. We suggest that the difference between fact and theory here may be the mathematical result of the interplay of low probability for occurrences and the few patients who until now have survived long enough for study. (auth)

11559 Quantification of combined radiation therapy and chemotherapy effects on critical normal tissues. Phillips, T.L.; Fu, K.K. (Univ. of California, San Francisco). *Cancer, Suppl.*; 37: No. 2, 1186-1200(Feb 1976).

From National Cancer Institute conference on delayed consequences of cancer therapy: proven and potential; Orlando, FL, USA (9 Jan 1975).

In order to determine the modification of radiation effect on critical normal tissues which occurs with combinations of radiation and cancer chemotherapy, a review of laboratory and clinical data has been carried out. Information on 10 different normal tissues is available. It is clear that the antibiotic cancer chemotherapeutic agents are the most likely to enhance radiation injury, with increased levels reported in all tissues except the central nervous system. The second most common type of injury with combination therapy appears to occur with drugs causing injury to the normal tissue on their own, such as adriamycin in the heart and methotrexate in the central nervous system. Quantification of the dose-effect factor is only available on a limited number of tissues and, primarily, in experimental animals. From these limited data, it is clear that dose-effect factors between 1.1 and 1.8 are seen, indicating that radiation doses must be reduced by 10 to 80 percent for the same level of injury when combined with chemotherapy. The augmentation of radiation damage by cancer chemotherapeutic agents is a serious problem in a wide range of tissues, but a problem which can be dealt with by accurate knowledge as to the dose-effect factor and appropriate modification of the radiation treatment. (auth)

11560 Initial comparative response to peak pions and x rays of normal skin and underlying tissue surrounding superficial metastatic nodules. Morton, M.; Kligerman, M.; West, G. (Univ. of New Mexico, Albuquerque). *Am. J. Roentgenol., Radium Ther. Nucl. Med.*; 126: No. 2, 261-267(Feb 1976).

From 57. annual meeting of the American Radium Society; Isla Verde, Puerto Rico (4 May 1975).

Given the limitations of available material and methods for measuring skin response, the relative biological effectiveness (RBE) for the development and healing of skin reaction to pions in this experiment is 1.43. This is based on data obtained from a patient with malignant melanoma, in whom multiple skin nodules and the surrounding normal skin were randomized into three dose levels for pions and x-rays. The RBE for skin reaction was obtained while the skin tumor nodules appeared to regress at least as rapidly with pion therapy as with x-rays. Wihout benefit of adequate observation of time required for nodule regrowth, any estimate of tumor RBE is speculative. (auth)

VERTEBRATES

REFER ALSO TO CITATION(S) 11520

11561 (AD/A—006428) **Effects of ^{60}Co on electrical self-stimulation of the brain and blood pressure. Topical report.** Bruner, A. (Lovelace Foundation for Medical Education and Research, Albuquerque, N.Mex. (USA)). 13 Dec 1974. Contracts DASA01-70-C-0059; DNA001-74-C-0098. 27p. NTIS $3.75.

The effects of 1000- and 2000-rad ^{60}Co on electrical self-stimulation of subcortical brain areas and blood pressure were investigated to determine whether radiation-induced performance decrement occurs in a like manner for a positively rewarded behavioral task as it does for the more typically studied shock-avoidance task. During the early post-radiation minutes, self-stimulation responses decreased or ceased and resumed shortly thereafter, revealing a similar course of performance decrement as seen with shock-avoidance, discrimination tasks. Early post-radiation hypotension with subsequent recovery paralleled the performance decrement, reproducing the blood pressure-behavior correlations seen previously with shock reinforcement. The blood pressure elevating influence of the brain stimulation observed prior to irradiation was diminished or absent during the deep hypotensive stage post-radiation, but tended to return minutes later. (GRA)

11562 (CONF-740930—) **Radiation and the lymphatic system. Proceedings of the fourteenth annual Hanford biology symposium, Richland, Washington, September 30—October 2, 1974.** (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.). 1976. 264p. Dep. NTIS $9.00.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

Separate abstracts were prepared for 33 of the 36 papers presented in these proceedings. One of the other three papers (Radiation and Lymph Node Function) was presented in abstract form only. Another of the papers (Reflections of a Wayfarer in Radiation Research) was a general paper. The third paper was a summary and comments on the conference. (ERB)

11563 (CONF-740930—, pp 144-148) **Effect of ionizing radiation on the transport of 2-aminoisobutyric acid in rat thymic and splenic lymphocytes.** Kwock, L.; Wallach, D.F.H.; Hefter, K.; Schnall, S. (Tufts New England Medical Center, Boston). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

The effects of gamma-irradiation on the Na^+-dependent 2-aminoisobutyric acid (AIB) transport system in rat thymic and splenic lymphocytes were compared. The results show that gamma-irradiation (0.25 to 10 krads) impairs the ability of lymphocytes from the thymus and spleen to accumulate AIB. The radiation effect is specific for this transport system since the transport of 1-aminocyclopentane-1-carboxylic acid (ACPC), a Na^+-independent system, is not affected in either organ by the levels of radiation used. This suggests that the cells are not becoming leaky and that the mechanism which affects AIB transport in thymic lymphocytes is the same in splenic lymphocytes. The radiation effect is both time and dose dependent, but anomalies were found in the uptake of AIB in the splenic lymphocytes as a function of both parameters in irradiated and nonirradiated splenic lymphocytes. These anomalies suggested that splenic lymphocytes contained a sensitive population of cells. The effect of radiation on lymphocytes from spleens treated with anti-rat lymphocyte serum (ALS) was compared with the effect on lymphocytes from nontreated spleens. The population of lymphocytes remaining after ALS treatment was much more radioresistant. This indicated that the sensitive population of lymphocytes in the spleen with respect to AIB transport was a thymus-derived cell population. Previously, insulin, which increases 2-aminoisobutyric acid influx by increasing the maximal rate of uptake, V/sub max/, was found to protect the thymocyte 2-aminoisobutyric acid system against the effects of radiation. In the case of splenic lymphocytes, no such protective effect was found. In both cases insulin (10^{-7} M to 10^{-12} M) stimulated AIB transport by 10 to 15 percent. This indicated that splenic lymphocytes do have insulin receptor sites but that the mechanism of the insulin radioprotective effect observed in thymocytes is not functioning in splenic lymphocytes. (auth)

11564 (CONF-740930—, pp 149-152) **Chronic blood irradiation: a new approach.** Hungate, F.P.; Riemath, W.F.; Bunnell, L.R.; Gillis, M.F. (Battelle Pacific Northwest Labs., Richland, WA). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

Extracorporeal irradiation of blood is beneficial in suppressing early rejection of renal allografts and in treating chronic lymphocytic leukemia. Previously, nearly all blood irradiation has involved brief intermittent exposures with high dose rates. The small amount of data available involving chronic irradiation suggests that doses given chronically at lower rates are more effective in suppressing graft rejection. However, no suitably portable device has been available to permit chronic irradiation. This work has been directed toward developing a fully portable irradiator. After preliminary testing of a variety of source materials, ^{170}Tm was selected for its favorable beta energy, low cost, and compatibility with the fabrication requirements. The body of the irradiator is cast from polyfurfuryl alcohol with subsequent high-temperature conversion to vitreous carbon. By sequential layering of the alcohol and suspending of $^{169}Tm_2O_3$ in the midlayer, a unit is produced without any radiation exposure and with the source material contained on both a macro and a micro scale. Exposure of the unit to reactor neutrons produces ^{170}Tm without activation of the vitreous carbon. A ^{170}Tm irradiator giving a transit dose of 16 rads (100 ml/min flow) was connected in a carotid—jugular shunt on a 20-kg goat. Lymphocyte levels decreased to about 15 percent of the preexposure level during the first week and thereafter slowly rose to about 50 percent of preexposure levels 2 months after exposure. Reciprocal skin grafts made at the end of irradiation (12 days) were rejected at 12 days on the nonirradiated control and at 24 days on the irradiated goat. These results are consistent with data reported on chronically irradiated baboons even though the dose rate for the present test was only about one-fourth that for the baboons. (auth)

11565 (CONF-740930—, pp 153-164) **Selective immunosuppression by radiation.** Chanana, A.D.; Cronkite, E.P.; Joel, D.D. (Brookhaven National Lab., Upton, NY). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

The historical aspects of selective irradiation of lymphocytes are reviewed as well as the problems concerned with dosimetry and the radiosensitivity of circulating blood elements other than lymphocytes. The possibilities of perturbations in steady-state lymphocytopoiesis which might be triggered by products of radiation-induced cell death are presented; however, the parameters investigated thus far, such as the degree of lymphocytopenia, thoracic duct lymphocyte output, and cell-cycle times of thoracic duct lymphocytes, have failed to reveal any such perturbations. Studies in adrenalectomized calves have failed to confirm the notion that lymphocytopenia after extracorporeal irradiation of blood and lymph might primarily be accounted for by stress-induced corticosteroid hormonal activity. Of the various techniques, only local-graft irradiation and extracorporeal irradiation of blood (ECIB) have found clinical application. The results obtained are encouraging and indicate a need for additional, well-controlled clinical trials, especially concerning the role of ECIB as an adjunct to standard immunosuppressive therapy. The experimental results with extracorporeal irradiation of lymph have also established the potential of this technique for clinical application. There is an urgent need for studying the influence of irradiation on various subpopulations of lymphocytes with regard to their functional capabilities and in particular with regard to their reproductive potential. Possible influence of selective blood irradiation on circulating stem cells in blood needs to be evaluated. (auth)

11566 (CONF-740930—, pp 169-174) **Radiation effects on the formation of effector cells and on the cytotoxicity of the effector cells.** Song, C.W.; Levitt, S.H. (Univ. of Minnesota, Minneapolis). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

The effect of radiation on the transformation of lymphocytes to antigen-specific immune lymphocytes and also on the cytotoxicity of the immune lymphocytes against allogeneic tumor cells was studied. Irradiation of peripheral lymphocytes of rats with 1000 rads of x rays did not significantly impair the phytohemagglutinin-induced blastogenesis and DNA synthesis, but it inhibited the subsequent division of the blast cells. The cytolysis of tumor cells in vitro by splenic immune lymphocytes was quantitated with release of ^{125}I-labeled iododeoxyuridine (^{125}I—IUdR) from the tumor cells labeled with the isotopes. The immune lymphocytes were rather radioresistant with regard to their cytotoxicity against the tumor cells. It was concluded that irradiation-induced immunosuppression might be due, not to a destruction of cytotoxic effector cells, but mainly to the suppression of formation of effector cells. (auth)

11567 (CONF-740930—, pp 175-184) **Radiosensitivity of antibody responses and radioresistant secondary tetanus antitoxin responses.** Stoner, R. (Brookhaven National Lab., Upton, NY); Terres, G.; Cottier, H.; Hess, M. 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

Primary tetanus antitoxin responses were increasingly repressed in mice when gamma radiation doses of 100 to 400 rads were delivered by whole-body exposure prior to immunization with fluid tetanus toxoid (FTT). Nearly normal secondary antitoxin responses were obtained in mice exposed to 600 rads of gamma radiation 4 days after secondary antigenic stimulation with FTT. A rapid transition from radiosensitivity of the antibody-forming system on days 1 to 3 was followed by relative radioresistance on day 4 after the booster injection of toxoid. Studies on lymphoid cellular kinetics in popliteal lymph nodes after injection of ^{3}H—thymidine (^{3}H—TdR) and incorporation of ^{3}H—L-histidine into circulating antitoxin were carried out. Analysis of tritium radioactivity in antigen—antibody precipitates of serums 2 hr after injection of the labeled amino acid revealed maximum incorporation into antibody around day 7 after the booster in nonirradiated controls and about day 12, i.e., 8 days after irradiation, in experimental mice. The shift from radiosensitivity to relative radioresistance was attributed to a marked peak of plasma-cell proliferation in the medulla of lymph nodes on day 3. Many medullary plasma cells survived and continued to proliferate after exposure to radiation. Germinal centers were destroyed by radiation within 1 day. Since antibody formation continued after exposure to radiation and after the loss of germinal centers, this supports the view that germinal-center cells were involved more in the generation of memory cells than in antibody synthesis. (auth)

11568 (UCD—472-122) **Annual report, fiscal year 1975.** Goldman, M. (California Univ., Davis (USA). School of Veterinary Medicine). Jun 1975. Contract E(04-3)-472. 231p. Dep. NTIS $7.60.

Separate abstracts were prepared for the 33 papers of the report. Twenty-four were included in Nuclear Science Abstracts, and all were included in ERDA Energy Research Abstracts. (HLW)

11569 (UCD—472-122, pp 2-12) **Pathology in a lifespan study of x-irradiated female beagles.** Chrisp, C.E.; Phemister, R.D.; Andersen, A.C. Jun 1975.

In Annual report, fiscal year 1975.

Clinical records, gross necropsy records, slides, and stored tissues of x-irradiated beagles were reviewed. Tables are presented to show preliminary determinations of causes of death, neoplasms found, and number of dogs at risk in relation to age and dose level. Mammary and ovarian tumors were more numerous in irradiated beagles and were partially responsible for shortening of lifespan. Neoplasms of the urogenital system were also increased in irradiated groups. (HLW)

11570 (UCD--472-122, pp 13-16) **Radiosensitivity of the fetal bonnet monkey ovary to fractionated x-irradiation.** Andersen, A.C.; Hendrickx, A.G.; Newman, L. Jun 1975.

In Annual report, fiscal year 1975.

Radiation damage to the ovary of the fetal bonnet monkey (M. radiata) from fractionated x-ray exposures of 11.5 rad (total 200 rad) varies somewhat, depending on the time in utero when oogenesis occurs. Follicle counts in twelve x-irradiated monkeys give evidence that 77 to 135 days postcoitum is a radiosensitive time for ovaries in most fetuses, but an occasional fetus is not sterilized by x-irradiation during this period if oogenesis occurs later in gestation. Apparently, prenatal irradiation can also delay oogenesis in this species. (auth)

11571 (UCD—472-122, pp 17-23) **Response of the genital tract to gonadotropin stimulation of the afollicular (x-irradiated) ovary in the beagle.** Andersen, A.C.; Momeni, M.H.; Stebbins, E. Jun 1975.

In Annual report, fiscal year 1975.

The morphologic response of the genital system in 16 beagles with afollicular (x-irradiated) ovaries has been examined following follicle and luteinizing hormone treatment. The dogs received a single brief exposure of 5 R daily or 10 R on alternate days from birth to 60 days of age (total 300 R). When the dogs were 7 months or older, the hormone treatment caused enlargement of the afollicular ovary and specific changes resembling proestrus in the oviduct and uterus; the vagina and vulva did not respond to the treatment. (auth)

11572 (UCD—472-122, pp 24-27) **Attempts to sterilize Tilapia zillii by gamma irradiation for introduction into an ecosystem.** Andersen, A.C.; Momeni, M.H.; Nelson, S.G.; Yeo, R.R. Jun 1975.

In Annual report, fiscal year 1975.

Tilapia zillii, a cichlid fish from northern Africa, was introduced into Florida, Alabama, Arizona, and California for aquatic weed control. A study was conducted to determine if the germ cells of the fish could be selectively destroyed by ionizing radiation in doses below the lethal range in order to obviate the potential ecological problems associated with proliferation of an exotic fish species. No demonstrable effect on the gonads was shown by gamma doses up to 3300 R. (HLW)

11573 (UCD—472-122, pp 51-73) **Hematological effects: comparative studies on the radiation survival characteristics in vivo and in vitro of bone marrow-derived clonogenic populations (CFU-C and PFU-C) and some observations on bone marrow cellularity in beagles.** Wilson, F.D.; O'Grady, L.; Momeni, M.; Wheeling, J.A.; Klein, K.; Graham, R.; Jow, N.; Di Bartola, S. Jun 1975.

In Annual report, fiscal year 1975.

Data accumulated for the hematological effects program are reviewed. Particular emphasis is given to the effects of acute and chronic irradiation on hematopoietic progenitor populations (CFU-C, colony-forming units in culture) and "candidate" mesenchymal progenitors (PFU-C, plaque-forming units in culture) using methylcellulose bone marrow culture systems and both in vivo and in vitro radiation exposure protocols. Preliminary results of studies on the temporal effects of acute x-irradiation on the capacity of PFU-C to generate colony stimulating activity (CSA) are also presented. The results of such experiments are providing the basis upon which future RBE studies on a variety of nuclides will be structured. Data (including age related changes) is also presented on in vivo bone marrow cellularity determinations, as well as for marrow stem cell quantitative studies using nondestructive techniques for normal Beagles. In these studies, two techniques for correction of variable effects of hemodilution are compared. Such studies are also providing baseline data for the ^{60}Co hematological effects program. (auth)

11574 (UCD—472-122, pp 109-110) **Effects of environment, radiation, and disease on serum copper and zinc levels in the beagle with applications to man.** Fisher, G.L. Jun 1975.

In Annual report, fiscal year 1975.

Serum copper and zinc levels were elevated in beagles with radioinduced osteosarcoma and human patients with primary osteosarcomas had elevated serum copper and zinc levels. Exposure to ^{226}Ra or ^{90}Sr did not alter serum copper or zinc, but serum zinc levels were elevated and serum copper levels were depressed in dogs receiving ^{60}Co whole-body irradiation. (HLW)

11575 (UCD—472-122, pp 137-138) **Transplantation of canine osteosarcoma into nude mice.** Shifrine, M.; Taylor, N.; Holloway, G.; Arnstein, P.R.; Chrisp, C.; Pool, R.; Whaley, C. Jun 1975.

In Annual report, fiscal year 1975.

Osteosarcomas from dogs were inoculated subcutaneously into mice. Sixty days later six mice had tumors that gradually increased in size. All tumors were undifferentiated sarcomas. Karyotypes of osteosarcomas grown in tissue culture and of tumors from mice inoculated with the culture were similar with two marker chromosomes. It was thus shown that radioinduced osteosarcomas can be cultivated in tissue culture while retaining their marker chromosomes and malignancy. (HLW)

11576 (UCD—472-122, pp 141-145) **Studies on macrophage activation.** Buhles, W.C.; Shifrine, M. Jun 1975.

In Annual report, fiscal year 1975.

Investigations were undertaken to study application of macrophage system manipulation for protection of neutropenic animals from bacterial infections following irradiation or cytotoxic drugs and to evaluate the effects of irradiation and cytotoxic drugs on macrophages. These experiments are based on the premise that activation of the macrophage system prior to induction of neutropenia will decrease the risk of subsequent bacterial infections. To these ends, we have developed a murine model of overwhelming gram-negative rod bacteremia in neutropenic animals, tested various modes of activating macrophages, and applied these methods in the study of protection of neutropenic animals from infections. Neutropenia was induced by use of cytotoxic drugs. Preliminary study showed that Cytoxan (cyclophosphamide, CY) administered to mice causes a profound neutropenia. (auth)

11577 **Postnatal development of the hippocampal dentate gyrus under normal and experimental conditions.** Altman, J.; Bayer, S. (Purdue Univ., Lafayette, IN). pp 95-122 of In Hippocampus. Vol. 1. Isaacson, R.L.; Pribram, K.H. New York; Plenum Publishing Corp. ([nd]).

Studies on postnatal maturation of the dentate gyrus are reviewed. Some topics discussed are: normal development of the dentate gyrus, cytogenesis, morphogenesis, synaptogenesis, gleogenesis, myelogenesis, development of the gyrus under experimental conditions, and effects of x radiation on cytogenesis and morphogenesis. (HLW)

11578 **Effects of x-irradiation on the postnatally-forming granule cell populations in the olfactory bulb, hippocampus, and**

cerebellum of the rat. Bayer, S.A.; Altman, J. (Purdue Univ., West Lafayette, IN). *Exp. Neurol.*; **48**: 167-174(1975).

Beginning on the second postnatal day, either two (2X group), four (4X group) or six (6X group) daily or alternate daily exposures to low-level x irradiation (150-200 r) were used to interfere with the acquisition of granule cells in the olfactory bulb, hippocampus, and cerebellum of the rat. At 60 days of age, the relationship between post-irradiation recovery and permanent granule cell loss was assessed with two quantitative techniques. First, the total number of granule cells was determined to estimate the magnitude of permanent loss. Secondly, the number of labeled granule cells were counted on day 60 after a ^{3}H-thymidine injection given on either day 15 or on day 20 to estimate differential rates of cell proliferation during the recovery period. Permanent loss of granule cells was sustained in all regions by all schedules of irradiation. The time for the most effective exposures was earlier in the hippocampus and olfactory bulb than in the cerebellum. In all regions, both the irradiated groups and the controls showed a decrease in the level of cell proliferation between 15 and 20 days. The number of cells that could be labeled after either the 15 or 20 day injection was below control levels for all groups in the hippocampus, at control levels for all groups in the cerebellum, and either at (2X and 4X) or below (6X) control levels in the olfactory bulb. These results are discussed in the light of the formation time of the granule cells in each region. (auth)

11579 Physiologic responses to exercise of irradiated and nonirradiated Shetland Ponies: a five-year study. Brown, D.G. (Comparative Animal Research Lab., Oak Ridge, TN). *Am. J. Vet. Res.*; **36**: No. 5, 645-652(May 1975).

Physiologic responses of irradiated and nonirradiated Shetland ponies to controlled exercise were measured over a period of 5 years. The 5-year test began when the ponies were 3 years old and 5 months after they were exposed to 650 R of ^{60}Co gamma radiation. Significant differences in heart rates, respiratory rates, and rectal temperatures were demonstrated between irradiated and nonirradiated ponies when subjected to exercise and high ambient temperatures. In the irradiated group, heart rates were usually slower, especially during recovery immediately after exercise, and respiratory rates and rectal temperatures were higher than these rates were in the nonirradiated group when exercising in ambient temperature of 29.5 C. Exhaustive exercise did not amplify any of the differences which were apparent with moderate exercise. From a general viewpoint, the irradiated ponies performed work as efficiently as did the nonirradiated ponies. Early changes in blood-cell concentrations after irradiation were similar to those which have been observed in other large animal species. Time required for the various types of blood cells to return to base line values ranged between 3 months and 3 years. (auth)

11580 Effects of x irradiation on the postnatally-forming granule cell populations in the olfactory bulb, hippocampus, and cerebellum of the rat. Bayer, S.A.; Altman, J. (Purdue Univ., Lafayette, IN). *Exp. Neurol.*; **48**: No. 1, 167-174(Jul 1975).

Beginning on the second postnatal day, either two (2X group), four (4X group) or six (6X group) daily or alternate daily exposures to low-level x irradiation (150 to 200 R) were used to interfere with the acquisition of granule cells in the olfactory bulb, hippocampus, and cerebellum of the rat. At 60 days of age, the relationship between post-irradiation recovery and permanent granule cell loss was assessed with two quantitative techniques. First, the total number of granule cells was determined to estimate the magnitude of permanent loss. Secondly, the number of labeled granule cells were counted on day 60 after a ^{3}H-thymidine injection given on either day 15 or on day 20 to estimate differential rates of cell proliferation during the recovery period. Permanent loss of granule cells was sustained in all regions by all schedules of irradiation. The time for the most effective exposures was earlier in the hippocampus and olfactory bulb than in the cerebellum. In all regions, both the irradiated groups and the controls showed a decrease in the level of cell proliferation between 15 and 20 days. The number of cells that could be labeled after either the 15 or 20 day injection was below control levels for all groups in the hippocampus, at control levels for all groups in the cerebellum, and either at (2X and 4X) or below (6X) control levels in the olfactory bulb. These results are discussed in the light of the formation time of the granule cells in each region. (auth)

11581 Postnatal development of the cerebellar cortex in the rat. IV. Spatial organization of bipolar cells, parallel fibers and glial palisades. Altman, J. (Purdue Univ., Lafayette, IN). *J. Comp. Neurol.*; **163**: No. 4, 427-448(15 Oct 1975).

The ontogeny of the spatial organization of some components of the molecular layer was investigated in cerebella sectioned systematically in the sagittal, coronal and horizontal planes. There is no discernible organization in the distribution of cells of the proliferative zone of the external germinal layer (EGL) but from birth the differentiating bipolar cells of the subproliferative zone are aligned parallel to the surface and to the long axis of the folium. While they are still in or at the base of the EGL, the bipolar cells emit long processes, the future parallel fibers. The next step is the outgrowth of a vertical process which may reach the base of the molecular layer before the granule cell nucleus becomes translocated. The idea that the cell body truly migrates through the molecular layer is not supported by the observations. Bergmann glial cells are frequently seen in Golgi material in neonates but they are probably less numerous than in older infants and their processes are not as well aligned. It is only gradually that the EGL is perforated by glial endfeet which in older infants are occasionally organized into longitudinal rows. In mature cerebella the parallel fibers are separated by thin and relatively narrow, unstained spaces which are oriented in the longitudinal plane and can be traced from the pial surface to a zone just above the layer of Purkinje cells. It is postulated that these spaces are occupied by glial palisades formed by apposed thin vertical processes to which many Bergmann glial cells contribute. The alignment of these palisades is dependent on the orientation of parallel fibers. When the parallel fibers are reoriented by x-irradiation the glial palisades become correspondingly realigned. (auth)

11582 Thyroidal radioiodine exposure of the fetus. Book, S.A.; Goldman, M. (Univ. of California, Davis). *Health Phys.*; **29**: No. 6, 874-877(Dec 1975).

Thyroid glands of developing fetuses are highly susceptible to radiation damage following maternal assimilation of radioiodines from nuclear fission or from medical diagnostic or therapeutic administration. The facility with which radioiodine is transported across the placenta assures fetal exposure to maternal radioiodine; the initiation of thyroid function in the young prior to parturition results in thyroidal concentration of radioiodine. Work in this field by a number of workers is correlated. The onset of radioiodine concentration by fetal thyroid glands for a number of mammals is tabulated. Fetal/maternal ratios of thyroidal ^{131}I concentration following (a) a single maternal administration and (b) chronic maternal exposure, are shown graphically for various mammals. (UK)

11583 Bone and bone marrow spaces in dosimetry of beagle skeletons. Momeni, M.H.; Pool, R.R. (Univ. of California, Davis). *Health Phys.*; **29**: No. 6, 877-881(Dec 1975).

Following previously reported work on temporal and spatial distribution of ^{90}Sr—^{90}Y and of ^{226}Ra in beagle humeri and skeleton , bone space parameters (surface, volume, and trabecular thickness) are here presented. Measurements were carried out by a coupled microscope-computer system. Implications of the bone space dimensions on local ^{90}Y—^{90}Sr and ^{226}Ra dose to osteo- genic and hematopoietic elements are discussed. (UK)

11584 Generation of cytotoxic T lymphocytes in vitro. VII. Suppressive effect of irradiated MLC cells on CTL response. Fitch, F.W.; Engers, H.D.; Cerottini, J.C.; Bruner, K.T. (Swiss Inst. for Experimental Cancer Research, Lausanne). *J. Immunol.*; **116**: No. 3, 716-723(Mar 1976).

Irradiated cells obtained from MLC at the peak of the CTL response caused profound suppression of generation of CTL when added in small numbers at the initiation of primary MLC prepared with normal spleen cells. The inhibitory activity of the MLC cells was not affected by irradiation (1000 rads) but was abolished by treatment with anti-tlheta serum and complement. The suppression was immunologically specific. The response of A (H-2/sup a/) spleen cells toward C3H (H-2/sup k/) alloantigens was suppressed by irradiated MLC cells obtained from MLC prepared with A spleen cells and irradiated C3H-stimulating cells, whereas the response of A spleen cells toward DBA/2 (H-2/sup d/) alloantigens was affected relatively little. However, if irradiated C3H x DBA/2F1 hybrid spleen cells were used to stimulate A spleen cells in MLC, addition of irradiated MLC cells having cytotoxic activity toward C3H antigens abolished the response to both C3H and DBA/2 antigens. The response to DBA/2 antigens was much less affected when a mixture of irradiated C3H and DBA/2 spleen cells was used as stimulating cells. Thus, the presence of MLC cells having cytotoxic activity toward one alloantigen abolished the response to another non-cross-reacting antigen only when both antigens were present on the same F1 hybrid-stimulating cells. This suppression of generation of CTL by irradiated MLC cells apparently involves inactivation of alloantigen-bearing stimulating cells as a result of residual cytotoxic activity of the irradiated MLC cells. This mechanism may be active during the decline in CTL activity noted in the normal immune response in vivo and in vitro. (auth)

INVERTEBRATES

11585 (LBL—4702) **Effects of weightlessness, gravity compensation and radiation on the flour beetle, Tribolium confusum.** Yang,

C.H.; Silver, I.L.; Tobias, C.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-ENG-48. 70p. Dep. NTIS $5.50.

Tribolium confusum, the flour beetle; was chosen as a test organism for determination of possible synergistic effects of radiation and space environment in the inertial flight of Biosatellite-II. The organism subjected to weightlessness and radiation during the flight exhibited greater than expected wing abnormalities. However, a postflight vibration control experiment produced anomalous results, and some doubt remained with respect to assigning weightlessness as the sole cause of the increased wing abnormalities. Results are reported from experiments performed on the interaction of gravity compensation, radiation, and Tribolium development. It was found that gravity compensation together with heavy ion irradiation did not cause more wing abnormalities than those caused by radiation alone. However, radiation and gravity compensation plus high temperature did cause an increased percentage of wing abnormalities. Two possible reasons are discussed. (CH)

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

MAN

REFER ALSO TO CITATION(S) 11553, 11594, 11595, 11618, 11651, 11652

11586 (ANL—75-60(Pt.2), pp 120-127) **Studies of the reproducibility of measurements of radioactivity in vivo.** Huff, D.R.; Markun, F.; Essling, M.A. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

A series of experiments is described which was designed to determine the variations caused in gamma-ray measurements of radioactivity in vivo by repeated positioning of a subject in the tilted chair, and by small changes in the position of the detector. The results of a week-long study of two radium cases are presented, and the variations in the measurement of both nonemanating and emanating ^{226}Ra are examined. (auth)

11587 (ANL—75-60(Pt.2), pp 128-130) **Revision of constants used in the calculation of the ^{226}Ra content for the Chris file VVRA.** Essling, M.A.; Markun, F.; Huff, D.R. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

Revised values for certain constants used in the calculation of the body content of ^{226}Ra are listed and modifications of values already entered in file VVRA are noted. (auth)

11588 (ANL—75-60(Pt.2), pp 131-133) **Measurements of attenuation coefficients for uranium L x rays in tissue-equivalent absorber.** Toohey, R.E. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

The attenuation coefficients at 13.6, 17.2, and 20.2 keV have been measured for a tissue-equivalent material. The results show the material to be marginally suitable for calibration purposes for the detection of ^{239}Pu in vivo. (auth)

11589 (ANL—75-60(Pt.2), pp 149-210) **Cell mediated immunity in patients with osteosarcoma.** Lloyd, E.L.; Henning, C.B. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

Because of the difficulty of obtaining suitable material, earlier studies on cell mediated immunity in the radium patients failed to include positive controls. Recently we were fortunate in obtaining samples of lymphocytes from two suitable patients who had had amputations for spontaneous osteosarcoma six months previously. Lymphocytes from both of these patients showed cytotoxicity to cultured cells derived from a human osteogenic sarcoma but not to normal fibroblasts. These results help to validate our test for early detection of osteosarcoma in the radium patients using measurements of cytotoxicity. (auth)

11590 (CONF-740930—, pp 113-119) **Chromosome breakage in lymphocytes from humans with body burdens of ^{226}Ra.** Hoegerman, S.F.; Cummins, H.T.; Bronec, J.F. (Argonne National Lab., IL). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

Peripheral lymphocytes from 10 controls and 40 patients with body burdens of ^{226}Ra ranging from below the limit of detection to 8.6 μCi were scored for unstable chromosome aberrations. The patient population was divided into four groups: a group with body burdens below the limit of detection (less than 0.003 μCi, 12 patients); a low-burden group (0.003 to 0.099 μCi, 13 patients); a moderate-burden group (0.1 to 0.99 μCi, 11 patients); and a high-burden group (greater than 1.0 μCi, 4 patients). In none of these groups was the frequency of cells with unstable aberrations significantly elevated above that in the controls. The rate of occurrence of dicentric and ring chromosomes was above the control frequency in only the two patients with the highest burdens (3.55 and 8.6 μCi). Our results are consistent with the expectation derived from a recent calculation of alpha dose delivered to blood by bone-deposited radium and its decay products. Marshall and Hoegerman have estimated that the blood dose for an individual with a radium burden of 1.0 μCi is 0.09 +- 0.03 rad/year. The value is compared with the dose estimate used by Boyd et al. in their study of British radium-dial painters, and the relevance of the blood dose to the lymphocyte dose is discussed. (auth)

11591 (CONF-740930—, pp 165-168) **Cell-mediated immunity as an early diagnostic test for osteosarcoma in human radium cases.** Lloyd, E.L.; Menon, M.; Mitchen, J.L. (Argonne National Lab., IL). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

Lymphocytes from patients carrying a body burden greater than 0.3 μCi of ^{226}Ra have been tested for specific cytotoxicity to four different osteosarcoma cell lines as well as to normal human fibroblasts. Cytotoxicity indexes (defined as the ratio of the number of target cells remaining, after treatment with the patients' lymphocytes, relative to the values obtained with normal control subjects) have been calculated. With one exception no cytotoxicity was observed. This is in agreement with the fact that no fresh osteosarcomas were diagnosed. The patient in whom cytotoxicity was found was suffering from an inflammatory lesion involving bone as the result of a foreign-body reaction at the time of the first test. When the test was repeated 10 months later, no cytotoxicity was observed. No significant nonspecific cytotoxicity was observed when lymphocytes from normal control subjects were interacted with any of the target cell lines. (auth)

11592 (ERDA—93, pp 244-255) **Cancer mortality among uranium mill workers.** Archer, V.E. (National Inst. for Occupational Safety and Health, Salt Lake City); Wagoner, J.K.; Lundin, F.E. Jr. 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

Mortality from all causes was determined for a small group of uranium mill workers. The only specific cause of death which demonstrated a significant excess was malignant disease of the lymphatic and hematopoietic tissue. Data from animal experiments suggests that this excess may have resulted from irradiation of lymph nodes by thorium-230. (auth)

11593 (UCRL-Trans—10999) **Study on the use of protactinium 233 as a simulator of plutonium 239 in pulmonary dosimetry.** Nikpay-Aslie, P. Translated from *Radioprotection;* **9**: No. 3, 205-210(1974). 10p. Dep. NTIS $3.50.

For the measurement of pulmonary charges induced by ^{239}Pu, an emitter of x-rays of very low energies, a method has been suggested consisting of administering an aerosol of ^{233}Pa. In effect, the ^{233}Pa with a short decay period, emits in addition to the same x-rays a photon γ of 310 keV, allowing the measurement of the administered radioactivity. For the measurement of low energies, the efficiency of a scintillation detector and proportional counter were compared by means of measurement made on an antropomorphous tissue equivalent phantom. The proportional counter permits the measurement of the x rays and confirms the use of ^{233}Pa as a simulator of ^{239}Pu. (auth)

ANIMALS

REFER ALSO TO CITATION(S) 11568, 11574, 11635

11594 (ANL—75-60(Pt.2)) **Radiological and Environmental Research Division annual report, July 1974—June 1975.** (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 212p. Dep. NTIS $8.75.

Separate abstracts were prepared for the 18 papers in the report. (HLW)

11595 (ANL—75-60(Pt.2), pp 1-38) **Theory of the induction of bone cancer by radiation: a preliminary report. I. A three-stage alpha particle model and the data for radium in man.** Marshall, J.H.; Groer, P.G. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

A model which involves two events of initiation and one of promotion yields an acceptable fit to the induction of osteosarcoma in the human radium cases. A three-dimensional system of analysis shows that the model fits the whole dose-time-response surface, the cumulative incidence versus radium intake, and the time distribution of tumors at each intake level. The two initiation events are produced in an endosteal cell by two alpha particles. The promotion event is related to the local rate of bone remodeling; being unrelated to radiation it provides an explanation for latent period. A competition between initiation and killing of endosteal cells provides an explanation for the plateau of tumor rate both in time and in level of intake for average skeletal doses greater than 1000 rads. (auth)

11596 (BNWL-SA—5563) **Pulmonary lesions induced by inhaled plutonium in beagles.** Dagle, G.E.; Lund, J.E.; Park, J.F. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 12p. (CONF-751043—7). Dep. NTIS $3.50.

From Workshop on the biological effects and toxicity of Pu 239 and Ra 226; Sun Valley, Idaho, USA (6 Oct 1975).

The histopathologic features of pulmonary fibrosis and bronchiolo-alveolar carcinoma in beagles exposed to aerosols of plutonium oxide were reviewed. A hypothesis of the pathogenesis of radiation pneumonitis induced by inhalation of plutonium oxide was presented; this hypothesis included phagocytosis of plutonium particles, fibrosis responding to the necrosis, and alveolar cell hyperplasia compensating for alveolar cells killed by alpha radiation. Histopathologic features of the epithelial changes suggest a progression from hyperplasia to metaplasia and, finally, to bronchiolo-alveolar carcinoma. The possibility of concurrent radiation-induced lymphopenia contributing to the development of bronchiolo-alveolar carcinoma through a loss of immunologic surveillance was discussed. (auth)

11597 (CONF-740930—, pp 83-89) **Influence of radiation-dose pattern from inhaled beta—gamma-emitting radionuclides on canine peripheral lymphocytes.** Jones, R.K.; Boecker, B.B.; Pickrell, J.A.; Hobbs, C.H.; McClellan, R.O. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

As part of studies assess the biological hazards associated with inhaled radionuclides, periodic hematologic evaluations were performed on beagle dogs given a single nose-only exposure to aerosols of beta—gamma-emitting isotopes. The physical form and specific radionuclides selected produced radiation-dose patterns representative of those which might be encountered in the event of human accidental exposures. Dogs received graded lung burdens of either ^{90}Y, ^{91}Y, ^{144}Ce, or ^{90}Sr, each in fused clay. Differences in the effective half-lives of these radionuclides resulted in a spectrum of cumulative radiation doses to lung delivered at a variety of dose rates. Since the form in which the radionuclides were inhaled was relatively insoluble, the lung and intrathoracic tissues represented the primary recipient of the dose. Regardless of the effective half-life of radionuclide retention, a dose-related depression of peripheral lymphocytes was observed at various times after inhalation exposure. The time at which maximum depression and subsequent recovery occurred, however, was most directly related to the effective half-life of the radionuclide. Of special interest was the persistence of lymphopenia through $2^1/_2$ years after exposure to ^{144}Ce and ^{90}Sr in fused clay where, other than tracheobronchial lymph nodes, the lymphoid tissue received very little radiation dose. The possible mechanisms responsible for lymphocyte depression from these various radiation-dose patterns are discussed. (auth)

11598 (CONF-740930—, pp 90-99) **Comparative effects of inhaled relatively insoluble forms of ^{90}Y, ^{144}Ce, and ^{90}Sr on canine peripheral lymphocyte function.** Benjamin, S.A.; Jones, R.K.; Snipes, M.B.; Lustgarten, C.S. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

Dogs that have inhaled relatively insoluble forms of either alpha- or beta-emitting radionuclides manifest a peripheral lymphopenia, the development and course of which depends on both total dose and dose rate. The remaining peripheral lymphocytes in dogs exposed to longer lived beta-emitting radionuclides showed a depressed function as measured by the ability to respond to plant mitogens in vitro. This experiment was designed to evaluate the effect of dose rate on peripheral lymphocyte function by exposing dogs to aerosols of radionuclides with varied effective half-lives in the lung: ^{90}Y (2.6 days), ^{144}Ce (170 days), and ^{90}Sr (650 days). Three groups of four adult beagle dogs each were exposed by inhalation to ^{90}Y, ^{144}Ce, or ^{90}Sr in fused-clay particles. Two controls were matched with each group. Initial lung burdens and initial dose rates to the lung were 520 to 610 μCi/kg of body weight and 2200 to 2600 rads/day in the ^{90}Y group, 33 to 60 μCi/kg and 200 to 350 rads/day in the ^{144}Ce group, and 25 to 32 μCi/kg and 130 to 170 rads/day in the ^{90}Sr group. Hematologic parameters and lymphocyte function as measured by the ability of lymphocytes to respond to plant mitogen stimulation were evaluated on a weekly or biweekly basis thereafter. The ^{90}Y-exposed dogs showed a marked lymphopenia within 1 week with a return to control levels by 20 weeks after exposure. The remaining peripheral lymphocytes, however, showed no functional changes in these dogs. Animals exposed to ^{144}Ce or ^{90}Sr developed a progressive and persisent lymphopenia and showed functional depression of the remaining lymphocytes as well. The relationships among dose pattern, lymphopenia, and lymphocyte-function depression are discussed. (auth)

11599 (CONF-740930—, pp 100-105) **Lymphocytopenia induced in beagle dogs by inhalation of $^{239}PuO_2$.** Ragan, H.A.; Park, J.F.; Olson, R.J.; Buschbom, R.L. (Battelle Pacific Northwest Labs., Richland, WA). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

To determine the life-span dose-effect relationships of inhaled plutonium, we gave 124 beagle dogs a single exposure of $^{239}PuO_2$ 2 to 3 years ago at six different levels, i.e., 4, 20, 80, 300, 1100, or 5800 nCi mean initial alveolar depositions. Another group (20 dogs) served as controls. All dogs were about 18 months old. At the four highest exposure levels, a chronic lymphocytopenia developed which correlated with the initial alveolar plutonium burden in regard to magnitude of depression and time of development after exposure. The nadir occurred near 10 months after exposure in dogs receiving 5800, 1100, and 300 nCi, with corresponding lymphocyte levels 40, 55, and 75 percent, respectively, of those observed in control dogs. In the 80-nCi level the nadir occurred about 2 years after exposure at approximately 80 percent of control values. At the two lowest doses, i.e., 4 and 20 nCi, no effect on lymphocyte concentrations was noted 3 years after exposure. The persistent lymphocytopenia related to plutonium inhalation may be of significance in the subsequent development of pulmonary neoplasms previously observed in beagles at this laboratory 8 to 11 years after initial lung depositions of 200 to 1000 nCi of ^{239}Pu. (auth)

11600 (CONF-740930—, pp 106-112) **Chromosome aberration frequency in blood lymphocytes of animals with ^{239}Pu lung burdens.** Brooks, A.L.; LaBauve, R.J.; McClellan, R.O.; Jensen, D.A. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

Other investigators have suggested a causal relationship between accidental ^{239}Pu exposures in man and the presence of chromosome aberrations in blood lymphocytes. For experimental assessment of this relationship, 16 rhesus monkeys and 171 Chinese hamsters were exposed to $^{239}PuO_2$ aerosols and an additional five hamsters were injected with ^{239}Pu citrate, and the frequency of aberrations in blood lymphocyte was determined. Hamsters with the highest lung burden had a median survival time of about 80 days. No deaths occurred in any of the other treated hamsters or monkeys by 250 days after ^{239}Pu inhalation. Hamsters sacrificed at 30 days showed an increase in chromosome aberration frequency with increasing dose to lungs. By 120 days after inhalation, the aberration frequency in the controls was 0.012. The frequency in animals with doses that produced significant life shortening had decreased to 0.018 and to 0.032 aberration/cell in animals with lower doses. At 380 days after injection of 2 nCi of ^{239}Pu citrate per gram of body weight, hamster lymphocytes had an aberration frequency of 0.048 aberration/cell. The level of chromosome damage in the $^{239}PuO_2$-exposed monkeys at 30 and 90 days after inhalation was not different from that observed in controls. Possible reasons for differences between the experimental animal observations and findings in man are discussed. (auth)

11601 (UCD—472-122, pp 112-117) **Clinical status and philosophy of clinical care of radionuclide-treated beagles.** MacMillan, K.; Holbrook, C.; White, R.; Chrisp, C. Jun 1975.

In Annual report, fiscal year 1975.

A manual for therapy of beagles is reviewed. The following protocol is outlined and described: antibiotic therapy, chemotherapy for neoplasms, hormone therapy, nutritional

therapy, radiation therapy, steroid therapy, and miscellaneous treatments. The manual also includes sections on diagnosis and discussions of individual cases. Tables summarizing clinical cases seen during 1974 are presented. (HLW)

11602 (UCD—472-122, pp 118-127) **Cumulative mortality in radionuclide-treated beagles.** Chrisp, C.E.; Pool, R.R.; Goldman, M.; Rosenblatt, L.S. Jun 1975.

In Annual report, fiscal year 1975.

Sixteen beagles treated with ^{226}Ra died during the past year. Osteosarcomas caused the death of nine and six beagles in the R30 and R20 levels, respectively. Only one other beagle in the ^{226}Ra injection series died during the past year, an R05 dog with severe chronic active interstitial pneumonia. The cumulative survival rate of R20 beagles is significantly lower than that of controls. (auth)

11603 (UCD—472-122, pp 128-129) **Distribution of ^{226}Ra-induced primary bone sarcomas in beagles.** Pool, R.R.; Williams, R.J.R. Jun 1975.

In Annual report, fiscal year 1975.

The distribution of ^{226}Ra-induced bone sarcomas in beagles is discussed. Diagrams of skeletons are presented to show distribution of tumors in the axial and appendicular bones. (HLW)

11604 (UCD—472-122, pp 132-134) **G-banding technique useful in the chromosomal analysis in the dog.** Whaley, C.; Taylor, N.; Sargent, A.; Wolf, H.G. Jun 1975.

In Annual report, fiscal year 1975.

Advantages of the G-banding technique for chromosomal analysis are discussed and the technique is described. A table is presented to show chromosomal counts on radioinduced osteosarcomas in ^{226}Ra- and ^{90}Sr-treated beagles and representative photographs of banded chromosomes are shown. (HLW)

11605 (UCD—472-122, pp 135) **In vitro assays for cell-mediated immunity in dogs with radiation-induced osteosarcoma.** Shifrine, M.; Taylor, N.J.; DeRock, E. Jun 1975.

In Annual report, fiscal year 1975.

The Radiobiology Laboratory experimental study on ^{226}Ra toxicity provides a model for the study of immune response in high-risk dogs and dogs with radiation-induced osteosarcoma. Studies were undertaken to measure both general immune response and specific immune response of dogs following amputation of the tumor-bearing limb using autochthonous cultured tumors. The cell-mediated immune competence (CMI) of dogs as measured by degree of stimulation of purified lymphocytes with phytohemagglutinin (PHA) has been determined in five available amputated dogs. The stimulation index was computed as the net ratio of ^{3}H-thymidine incorporation in stimulated vs unstimulated cells. (auth)

11606 (UCD—472-122, pp 136) **In vitro cultivation of canine osteosarcoma.** Shifrine, M.; Taylor, N.J.; Holloway, G.L.; DeRock, E. Jun 1975.

In Annual report, fiscal year 1975.

Radioinduced osteosarcomas were grown in tissue culture; this provides a source of tumor-specific antigen for assaying antibodies directed against the osteosarcoma. Studies were conducted on cell-mediated immunity of ^{226}Ra-exposed dogs and the correlation of the immune response with radioinduced osteogenesis. (HLW)

11607 (UCD—472-122, pp 160-162) **Chemical analysis and quantitation of the tapetum lucidum.** Gee, N.A.; Fisher, G.L.; Nash, C.P. Jun 1975.

In Annual report, fiscal year 1975.

A study was conducted to provide a basis for the evaluation of the biochemical nature of the ^{226}Ra alterations of the beagle tapetum. Results indicated that zinc and/or melanin determinations in the tapetum nigrum and tapetum lucidum may allow quantitation of tapetum lucidum tissue without the need for physical separation of the tapetal layers. (HLW)

11608 **Prevention of radiation pneumonitis from inhaled ^{144}Ce by lung lavage in beagle dogs.** Muggenburg, B.A.; Mauderly, J.L.; Boecker, B.B.; Hahn, F.F.; McClellan, R.O. (Inhalation Toxicology Research Inst., Albuquerque, NM). *Am. Rev. Respir. Dis.*; **111**: No. 6, 795-802(Jun 1975).

This study was performed to evaluate bronchopulmonary lavage and chelation therapy as a treatment method to prevent the development of radiation pneumonitis after inhalation of a radioactive aerosol. Twelve beagle dogs were exposed to an aerosol of cerium-144 in fused clay particles resulting in initial lung burdens from 47 to 64 μCi of ^{144}Ce per kg of body weight. Eight of the dogs were treated with a series of 10 bronchopulmonary lavages and 10 intravenous injections of calcium diethylenetriamine pentaacetate acid during the first 56 days after exposure to remove the deposited ^{144}Ce; the remaining 4 exposed dogs received no treatment. An additional 4 dogs were exposed to stable cerium and were given the course of treatment as an additional control group. Three of the 4 untreated dogs and 2 of the 8 treated dogs died 171 to 246 days after exposure with radiation pneumonitis or pulmonary fibrosis, or both. All but one of the remaining dogs were alive and apparently in good clinical health 550 days after exposure; the one dog had radiographic indications of pulmonary fibrosis by 365 days after exposure. The relative distribution of ^{144}Ce in the lungs and other major organs was similar in the treated and untreated dogs that died. (auth)

NUCLIDE KINETICS AND TOXICOLOGY

REFER ALSO TO CITATION(S) 11469

11609 (ERDA—93, pp 436-441) **Purposes and functions of air sampling programs.** Schulte, H.F. (Los Alamos Scientific Lab., NM). 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

Air sampling programs can serve many purposes, and the equipment and sampling strategy used will vary with the purpose to be served. This paper describes the distinctive features of uranium air sampling programs for estimating health effects, determining compliance with regulations, evaluating control systems, warning the employee, locating pollution sources, indicating possibilities of explosions, and defining the need for supplemental programs such as bioassay. (auth)

MAN

REFER ALSO TO CITATION(S) 11594, 11629

11610 (ANL—75-60(Pt.2), pp 86-88) **Plutonium in the blood of two subjects 10^4 days after injection.** Rundo, J.; Larsen, R.P.; Ilcewicz, F.H. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

The excretory plasma clearance of ^{239}Pu in two subjects 10^4 days after intravenous injection was in the range 0.1 to 0.2 l/day. The plasma concentrations per liter were 0.013 percent and 0.043 percent of the retained body contents for the two subjects, respectively. (auth)

11611 (ANL—75-60(Pt.2), pp 89-91) **Excretion rate and retention of plutonium 1000 days after injection.** Rundo, J.; Starzyk, P.; Larsen, R.P.; Oldham, R.D.; Sedlet, J.; Robinson, J.J. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

During 1945 to 1947 two persons received intravenous injections of ^{239}Pu as the citrate and one person received ^{239}Pu as the nitrate. Samples of urine and feces were analyzed for Pu for eight days. Results were used to calculate mean daily excretion rates at 10,000 days post-injection. Total excretion and retention were calculated in the form of a balance sheet and results are tabulated. (HLW)

11612 (ANL—75-60(Pt.2), pp 92-95) **Preliminary report on the macrodistribution of radioactivity in the skeleton of an individual who received plutonium by intravenous injection.** Toohey, R.E.; Larsen, R.P.; Ilcewicz, F.H. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

The concentration of plutonium has been determined in several bone samples from the skeleton of an individual who had received this element by intravenous injection in 1945. The analyses were based on measurements of uranium L x rays with a large xenon-filled proportional counter. The results have been confirmed by radiochemical analysis. The presence of ^{241}Am in the samples has been established. The plutonium content of the skeleton estimated from these measurements is consistent with the values obtained from measurements of the microdistributions on bone surfaces. (auth)

11613 (ANL—75-60(Pt.2), pp 98-111) **Retention and excretion of strontium-90 by a former dial painter (Case 01-576).** Holtzman, R.B.; Ortman, M.; Keane, A.T. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

Excretion rates of ^{90}Sr by a former dial painter, Case 01-576, were determined on excreta collected in 1968. She excreted 249 and 64 pCi/day in urine and feces, respectively, or about 7 percent of the body content per year. Analysis of the data on this

subject indicated that the power function described the retention and excretion rates better than did the single exponential. (auth)

11614 (ANL—75-60(Pt.2), pp 112-115) **Calcium in blood, plasma, and red blood cells.** Kuchta, D.R.; Sha, J.Y. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

The concentrations of calcium in plasma and the cellular fraction of blood and red blood washed by a dilution method to remove entrained plasma were determined. After four washings the cells contained 0.082 +-0.012 of the total blood calcium. The average concentration of Ca in washed cells was at least an order of magnitude lower than that of the average plasma concentration of 96 mg/kg. (auth)

11615 (ANL—75-60(Pt.2), pp 116-119) **Intralaboratory comparison of the measurement of ^{226}Ra in small samples of human bone.** Huff, D.R.; Sha, J.Y. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

^{226}Ra was measured in selected samples of human bone by both γ-ray spectrometry and radiochemical analysis. There appears to be a systematic difference of approximately 8 percent between the two methods; this is about the same as the combined systematic errors which had previously been estimated for these methods. (auth)

11616 (ANL—75-60(Pt.2), pp 134-136) **Rapid method for estimating the effective depth of internally-deposited ^{241}Am.** Toohey, R.E.; Rundo, J. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

The effective depth of the ^{241}Am in a contaminated subject can be estimated by dividing the 60-keV photopeak into roughly equal energy bands and determining the ratio of counts in the lower-energy half to those in the higher-energy half. This ratio was found to be an approximately linear function of the thickness of absorber covering the source over the range of absorber thicknesses of interest. The exact relationship between the ratio and the absorber thickness will be a function of both the energy bands chosen and the particular detector employed. The method is especially applicable to long-term studies of cases of inhalation of ^{241}Am. (HLW)

11617 (CONF-740930—, pp 67-72) **Uptake kinetics of relatively insoluble particles by tracheobronchial lymph nodes.** Thomas, R.G. (Los Alamos Scientific Lab., NM). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

Tracheobronchial lymph nodes accumulate a portion of material deposited in the deep lung following inhalation of relatively insoluble particles. Experiments involving a variety of compounds, inhaled singly or repeatedly, indicate that the kinetics of lymph node uptake are fairly independent of particle characteristics and mammalian species. The buildup per unit weight of nodal tissue compared with that of lung tissue, with time, can be represented by a linear logarithmic function. However, since the scatter in experimental points may be large at any given time after inhalation exposure, a number of different kinetic descriptions of uptake can be derived. The logarithmic pattern of accumulation can be approximated over an extended time range (several years) by use of a combination of first-order kinetics of loss from the lung and of buildup in lymph nodes, but it is recognized that the processes are much more complicated than this treatment would indicate. Clearance (loss) from the lymph nodes is not well defined, but this aspect is discussed in light of the kinetic models presented. (auth)

11618 (ERDA—93) **Conference on occupational health experience with uranium, Arlington, Virginia, 28—30 April 1975.** (Energy Research and Development Administration, Washington, D.C. (USA)). 1975. 461p. (CONF-750445—). Dep. NTIS $13.00.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

Separate abstracts were prepared for 18 papers. Six papers were abstracted previously and appeared in NSA volume 32 as numbers 5912, 6044, and 6427, and volume 33 as numbers 992, 3283, and 6370. (CH)

11619 (ERDA—93, pp 8-24) **Early occupational exposure experience with uranium processing.** Eisenbud, M. (New York Univ. Medical Center). 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

The uranium production chain during and immediately following World War II is described. The high levels of dust exposure that then existed are summarized in relation to the concentration of uranium found post-mortem in lung and bone. The need for systematic epidemiological followup is emphasized. (auth)

11620 (ERDA—93, pp 25-34) **Origin and basis of present standards for uranium.** Hursh, J.B. (Univ. of Rochester, NY). 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

The history of the maximum permissible concentration in air, (MPC)/sub a/, for occupational exposure to natural uranium is reviewed. The assumptions made for the calculation of the present (ICRP-NCRP) limits for soluble and insoluble compounds of uranium are stated and commented upon. The point of view is expressed that industrial experience, rather than the validity of the calculations, may now be a more satisfactory justification for safety of the present limits for natural uranium. Limits for single uranium isotopes and for isotope mixtures (other than natural uranium) are considered. (auth)

11621 (ERDA—93, pp 215-224) **Statistical summary of ERDA contractors' internal enriched uranium exposure experience, 1957—1974.** Ross, D.M.; Campbell, C.M. (Energy Research and Development Administration, Washington, DC). 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

A compilation is presented of 18 years internal uranium exposure experience of 6 contractors. It is evident that if one expects to detect the presence of uranium in the lung one should have an in-vivo counter available; as these facilities get older more maintenance workers have accumulated uranium lung burdens. Although ERDA contractors have not exceeded the annual lung dose limit during the past 5 years, there may still be room for improvement in the control of airborne uranium in some facilities. (auth)

11622 (ERDA—93, pp 401-418) **Role of particle size in the evaluation of uranium hazards.** Mercer, T.T. (Univ. of Rochester, NY). 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

The pattern of uranium deposition in the respiratory tract, which is determined primarily by size-related particulate properties is shown to be affected significantly by particle densities as large as those of the uranium oxides. The size distributions of pulmonary particulate deposits, estimated from pulmonary deposition curves for dense particles, are roughly lognormal and show modal logarithms in the aerodynamic size range of 0.2 to 3.0 μm. Solubility clearance constants, which are related to the size distribution of the pulmonary deposit, have been calculated for a number of human exposures. The results are discussed in terms of the significance of particle size. (auth)

11623 (ORNL/TM—5257) **Review of John W. Gofman's reports on health hazards from inhaled plutonium.** Richmond, C.R. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 24p. Dep. NTIS $5.00.

This document is a review of two reports prepared in 1975 by John W. Gofman on the subject of plutonium toxicity. Because Gofman's estimates of the calculated health effects from inhaled plutonium are significantly higher than those obtained from other analyses (including the risk estimates calculated by the National Academy of Science's Advisory Committee on the Biological Effects of Ionizing Radiation), it was decided to critically review Gofman's papers and supporting arguments. This review concludes that Gofman's predictions of large numbers of plutonium-induced lung cancers from nuclear weapons testing are derived mainly from his incorrect assumptions about the effects of cigarette smoking on the retention of plutonium particulates in the tracheobronchial region of the lungs. It appears that Gofman's assumptions are considerably overstated and cannot be substantiated by currently available information. Also, Gofman's attempt to equate a given number of lung cancer deaths to a pound of plutonium tends to obfuscate rather than clarify attempts to derive risk estimates for inhaled plutonium. (auth)

11624 **Cesium-134 in human autopsy tissue.** Ide, H.M.; McInroy, J.F. (Los Alamos Scientific Lab., NM). *Health Phys.*; **29**: No. 6, 871-872(Dec 1975).

During examination of human autopsy tissue by γ counting, carried out since 1971, ^{134}Cs has been identified in 42 out of 621 sets of tissue investigated. Plans are underway to obtain complete medical, occupation, and residence histories on each of these cases to identify the source of this activity. However 14 of the 16 cases whose medical histories are known have been identified as having received /sup 99m/Tc for scanning purposes. It has been shown by previous workers that ^{134}Cs is a contaminant on the columns and in the eluates of some commercial /sup 99m/Tc generators. Reported contaminations by ^{134}Cs of various aspects of the environment are listed. It is stressed that due to the wide-spread use of /sup 99m/Tc in medical scanning procedures, the appearance of ^{134}Cs in human tissue due to the contamination of the generators should be of interest to those radiologists making dose calculations. (UK)

ANIMALS

REFER ALSO TO CITATION(S) 11470, 11517, 11594, 11618

11625 (ANL—75-60(Pt.2), pp 96-97) **Progress report on the development of the fission track method for the determination of plutonium in biological materials.** Larsen, R.P.; Oldham, R.D. 1975.

In Radiological and Environmental Research Division annual report, July 1974—June 1975.

In the development of the fission track method for the determination of plutonium, conditions have been established for limiting the interference of uranium in the determination to a plutonium equivalent of 0.2 fCi. (auth)

11626 (BNWL-SA—5363) **Overview of plutonium toxicity.** Thompson, R.C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975.Contract E(45-1)-1830. 12p. (CONF-751105—19). Dep. NTIS $3.50.

From IAEA international symposium on transuranium nuclides in the environment; San Francisco, California, USA (17 Nov 1975).

Data are reviewed from studies on the pathological effects of low exposure levels of Pu in dogs, mice, and rats. Emphasis is placed on the incidence of bone tumors following parenteral administration or ingestion of Pu at various concentrations and in various chemical forms and the incidence of lung and bone tumors following inhalation of Pu. Problems involved in the extrapolation of animal data to man and in the extrapolation of low-dose effects to the effects of extremely low doses involved in the environmental dispersion of transuranium compounds are discussed. (CH)

11627 (CONF-740930—, pp 2-9) **Studies of plutonium and the lymphatic system: six years of progress at Colorado State University.** Lebel, J.L.; Bistline, R.W.; Schallberger, J.A.; Dagle, G.E.; Gomez, L.S. (Colorado State Univ., Fort Collins). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

Air-oxidized PuO^{2}, high-fired (850°C) PuO_2, $Pu(NO_3)_4$, PuF_4, and $PuCl_3$, all of which had known amounts of ^{241}Am, were implanted over the left metacarpus of beagles. The concentration of plutonium and ^{241}Am in various tissues was measured as a function of time. The effect of diethylenetriaminepentaacetate (DTPA) therapy on organ deposition was studied. Significant differences in the translocation dynamics of air-oxidized PuO_2, high-fired PuO_2, and $Pu(NO_3)_4$ in the left superficial cervical lymph node (LSCLN) were observed by in vivo measurement and radiochemical analysis. A 3 percent buildup of plutonium was observed 2 weeks after implantation of air-oxidized PuO_2, with an exponential buildup to 17 percent at 1 year. With $Pu(NO_3)_4$ and high-fired PuO_2, the activity accumulation built up to a peak of 31 and 20 percent, respectively, at 30 and 60 days after implantation, followed by a gradual regression. At the implant site 1 year postimplant, a 70 percent reduction in activity was observed with $Pu(NO_3)_4$, a 90 percent reduction with PuO_2 (high-fired), and only a 20 percent reduction with air-oxidized PuO_2. The effect of larger particle size on the movement of plutonium from a wound site was speculated. Chemical form and physical form appear to change the rate of translocation and relative depositions of plutonium and americium in various organs.Particle size was not found to be an important factor in the total movement of plutonium in afferent and efferent lymph. More plutonium moves in the cellular fraction of afferent and efferent lymph regardless of particle size. The clearance of plutonium particles from the lymph nodes was associated with necrosis of macrophages. The effect of DTPA therapy on plutonium concentration was greater for the nitrate than for the other chemical forms. (auth)

11628 (CONF-740930—, pp 10-18) **Translocation dynamics of $Pu(NO_3)_{42}$ from puncture wounds to lymph nodes and major organs of beagles.** Bistline, R.W.; Lebel, J.L.; Dagle, G.E. (Colorado State Univ., Fort Collins). 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

The translocation dynamics of plutonium and americium from simulated puncture wounds in the paws of beagle dogs following contamination with $Pu(NO_3)_4$ and high-fired PuO_2 was studied. Fractions of initial implant transported to the first major lymph node and to major body organs were measured with in vivo counting equipment and by radiochemical analysis of tissue material collected at necropsy. Samples were obtained from serial necropsies ranging from 2 weeks to 1 year after implant. The difference in lymph node and organ-accumulation dynamics between the two chemical forms and the effects of diethylenetriaminepentaacetate (DTPA) chelation treatment are presented. Active mechanisms to transport plutonium to and from the lymph system appear to exist. Equations for buildup in the lymph nodes and organs are included. The data suggest a buildup in the lymph node to a maximum, followed by a long negative slope, and a possible dose-rate effect from $Pu(NO_3)_4$ in lymph nodes. (auth)

11629 (CONF-740930—, pp 59-66) **In vivo detection of plutonium in the tracheobronchial lymph nodes with a fiber-optic coupled scintillator.** Swinth, K.L. (Battelle Pacific Northwest Labs., Richland, WA); Park, J.F.; Voelz, G.L.; Ewins, J.H. 1976.

From 14. Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In Radiation and the lymphatic system.

An intraesophageal probe was developed for measuring plutonium in the tracheobronchial lymph nodes. The probe uses a fiber-optic coupled NaI(Tl) scintillator as a detector and has a detection limit one-tenth that of a solid-state probe previously used for this measurement. The probe, with a projected sensitivity of 1 cpm/nCi, was used to detect plutonium in the lymph nodes of 11 experimentally exposed dogs. Tests on an accidentally exposed human volunteer yielded positive counts from the lymph nodes from an amount estimated at 7 nCi in the tracheobronchial lymph nodes. (auth)

11630 (ERDA—93, pp 67-129) **Metabolism and effects of uranium in animals.** Durbin, P.W. (Univ. of California, Berkeley); Wrenn, M.E. 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

This paper summarizes the results of animal experiments that are the foundation of our current understanding of the biological behavior or uranium. Topics discussed include: metabolism including biological transport, excretion, deposition and retention in kidney and bone; absorption after parenteral administration, feeding, inhalation, or application to skin or eye; maternal transfer; and clearance of inhaled compounds from the lung. Acute chemical toxicity, including mechanism of action and effects on renal tubules; effects on blood and urine chemistry; acute mortality after parenteral administration or application to skin or eye; and the acute toxicity of ^{233}U. Chemical toxicity after prolonged exposure, including mortality; kidney function and pathology during chronic ingestion or inhalation; and tolerance to uranium poisoning. Radiation effects, including induction of bone tumors by soluble ^{233}U or ^{233}U; subacute mortality from ^{233}U; pneumonia and fibrosis in lung and induction of lung tumors by inhaled oxides of ^{235}U or natural U. (auth)

11631 (ERDA—93, pp 130-139) **Inhalation of uranium ores.** Stuart, B.O. (Energy Research and Development Administration, Washington, DC); Jackson, P.O. 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

In previous studies the biological dispositions of individual long-lived alpha members of the uranium chain (^{230}U, ^{234}U and ^{230}Th) were determined during and following repeated inhalation exposures of rats to pitchblende (26 percent U_3O_8) ore. Although finely dispersed ore in secular equilibrium was inhaled, $^{230}Th/^{234}U$ radioactivity ratios in the lungs rose from 1.0 to 2.5 during 8 weeks of exposures and increased to 9.2 by four months after cessation of exposures. Marked non-equilibrium levels were also found in the tracheobronchial lymph nodes, kidneys, liver, and femur. Daily exposures of beagle dogs to high levels of this ore for 8 days resulted in lung $^{230}Th/^{234}U$ ratios of >2.0. Daily exposures of dogs to lower levels (0.1 mg/l) for 6 months, with sacrifice 15 months later, resulted in lung and thoracic lymph node $^{230}Th/^{234}U$ ratios ranging from 3.6 to 9 and nearly 7, respectively. The lungs of hamsters exposed to carnotite (4 percent U_3O_8) ore in current

lifespan studies show $^{230}Th/^{234}U$ ratios as high as 2.0 during daily inhalation of this ore in secular equilibrium. Beagle dogs sacrificed after several years of daily inhalations of the same carnotite ore plus radon daughters also showed marked non-equilibrium ratios of $^{230}Th/^{234}U$, ranging from 5.6 to 7.4 in lungs and 6.2 to 9.1 in thoracic lymph nodes. This pattern of higher retention of ^{230}Th than ^{234}U in lungs, thoracic lymph nodes, and other tissues is thus consistent for two types of uranium ore among several species and suggests a reevaluation of maximum permissible air concentrations of ore, currently based only on uranium content. (auth)

11632 (UCD—472-122, pp 30-31) **^{131}I uptake in newborn beagles.** Book, S.A. Jun 1975.

In Annual report, fiscal year 1975.

Tracer studies with pups less than 36 hr of age showed an average peak ^{131}I uptake of 14.4 percent (128 percent/g), and a T/sub E/ of approximately 4.4 days. The estimated dose to the thyroid gland was about 90 rads per μCi administered vs. approximately 11 rads per μCi for the adult. (auth)

11633 (UCD—472-122, pp 32-38) **Thyroidal uptake and retention of ^{131}I by pregnant and fetal guinea pigs.** Book, S.A.; McNeill, D.A. Jun 1975.

In Annual report, fiscal year 1975.

Preliminary studies on thyroidal ^{131}I concentration by fetal guinea pigs indicate a peak uptake approximately 7 times that of the maternal gland, with an effective half-life of less than 2 days. The resultant dose was estimated to be 37 rads for the maternal gland and from 60 to 81 rads for the fetal gland per microcurie administered. From 1 to 11 days after maternal injection of ^{131}I, amniotic fluid contained more ^{131}I per liter than did fetal blood which in turn had a greater concentration than did maternal blood. (auth)

11634 (UCD—472-122, pp 44-49) **Bone and marrow spaces of beagle skeletons in dosimetry of ^{90}Sr and ^{226}Ra.** Momeni, M.H. Jun 1975.

In Annual report, fiscal year 1975.

Humeral surface and volume and trabecular thickness were measured by a coupled microscope-computer system. Implications of the bone space dimensions on local $^{90}Sr—^{90}Y$ and ^{226}Ra dose to osteogenic and erythrogenic elements are discussed. Microradiographs are shown of transverse and sagittal sections of the beagle humerus. (HLW)

11635 (UCD—472-122, pp 50) **Dose rates, dose and age effects of $^{90}Sr—^{90}Y$ and ^{226}Ra body burden on radiation-induced skeletal injury, primary bone sarcomas and mortality in beagles.** Momeni, M.H.; Williams, J.R.; Jow, N.; Rosenblatt, L.S. Jun 1975.

In Annual report, fiscal year 1975.

Radiation-induced skeletal injury (E), primary bone sarcomas (PBS) and lifespan shortening (Δ) were studied in beagles fed $^{90}SrCl_2$ for 1.5 years or administered ^{226}Ra Cl (iv) over four months starting at 2, 4, or 14 months of age. Lifespan shortening was compared with that caused by a single injection of ^{90}Sr or ^{226}Ra or by inhalation of $^{90}SrCl_2$. Skeletal changes were assessed by a radiographic x-ray score. Bone changes in ^{90}Sr or ^{226}Ra labeled humeri were compared with skeletal scores. Skeletal changes classified included endosteal and/or periosteal cortical sclerosis and thickening (ECST, POCST), fractures, osteolytic lesions, and trabecular coarsening. ECST incidence was 100 percent in at least one site in dogs receiving greater than 9.3 μCi ^{226}Ra and POCST incidence was 100 percent only at greater than or equal to 83.6 μCi ^{226}Ra. At 0.53 μCi ^{226}Ra, ECST and POCST incidence were both 5 percent. Fractures were observed at 14 μCi ^{226}Ra and were 50 percent and 100 percent at 28.1 μCi ^{226}Ra and 83.6 μCi, respectively. (auth)

11636 (UCD—472-122, pp 90-101) **Retention and distribution of ^{226}Ra in beagles: a comparison between multiple and single injections.** Momeni, M.H.; Rosenblatt, L.S.; Jow, N.; Dunford, P.; Soo, S.; Coffelt, S. Jun 1975.

In Annual report, fiscal year 1975.

Skeletal uptake, retention, and distribution of ^{226}Ra were studied in 330 beagles administered eight semi-monthly i.v. injections of radium starting at 2, 4, and 14 months of age. Skeletal uptake, the ratio of body burden at 35 days post-injection (A_{35}) to the total injected dose (A_0) was 71.7 percent, 78.1 percent and 38.5 percent, for a dose of 10 μCi/kg body weight administered starting at 2, 4, and 14 months of age, respectively. Skeletal retention of radium 350 days post-injection (A_{350}/A_0) was 67.2 percent, 73.3 percent, and 27.7 percent. Comparison of ^{226}Ra retention from single and multiple injections of radium shows that at dose level 6.064 μCi/kg the retention functions for periods 35 days after injection are identical; for dose level 10 μCi/kg, a larger retention is observed for multiple-injection groups. Comparison of ^{226}Ra retention in man with that in beagles shows that within a period between 35 days and 6000 days post—injection, the body burden in dog decreases by about 6 times in contrast with 43 times in man. Regional distribution of ^{226}Ra in bone matrix at proximal, midshaft, and distal humeri from 21 beagles shows the highest concentration of the radionuclide at proximal regions. Radium distribution on autoradiograms shows a uniform distribution in 4-month-old beagles in contrast to "hot spots" superimposed on a diffuse background for the 14-month age group. Radium in the latter group is located mostly on periosteum and endosteum surfaces. (auth)

11637 (UCD—472-122, pp 102-108) **Distribution of $^{90}Sr—^{90}Y$ dose injected into or ingested by beagles.** Momeni, M.H.; Jow, N.; Bradley, E. Jun 1975.

In Annual report, fiscal year 1975.

Tables and graphs are presented to show the following data after injection or ingestion of $^{90}Sr—^{90}Y$: average body weight and growth rate; skeletal growth pattern; ratio of dry humerus weight to dry skeletal weight; $^{90}Sr—^{90}Y$ concentration and dose rate measured by thermoluminescent dosimetry for three bone regions; retention parameters for $^{90}Sr—^{90}Y$ ingestion; dose rates to bone marrow; local dose rate and $^{90}Sr—^{90}Y$ concentration at depicted regions of third lumbar vertebra; average dose rate to skeletons of male and female beagles; and body burden retention normalized to $^{90}Sr—^{90}Y$ injection dose. (HLW)

11638 **Elimination of ^{137}Cs and ^{59}Fe and its relationship to metabolic rates of wild small rodents.** Baker, C.E.; Dunaway, P.B. (Oak Ridge National Lab., TN). *J. Exp. Zool.*; **192**: No. 2, 223-236(1975).

Elimination of ^{137}Cs and ^{59}Fe by three species of wild rodents was measured in laboratory and field experiments to determine whether excretion rates of these nuclides are influenced directly by general metabolic (CO_2 production) rates. Sigmodon hispidus and Peromyscus leucopus were used in both field and laboratory experiments, and Reithrodontomys humulis was investigated only in the laboratory. Final-component biological half-lives (T/sub b/) of ^{59}Fe for Sigmodon averaged 108 days in winter, 144 days in spring, and means ranged from 176 to 242 days under various laboratory conditions (ambient temperature, cold-exposure, irradiation, and chemical metabolic inhibition); for Peromyscus, values were 50 days in winter, 47 days in spring, and 289 days (at ambient temperature only) in the laboratory; for Reithrodontomys mean values ranged from 121 to 178 days at different laboratory treatment levels. Biological half-lives of final-component ^{137}Cs elimination for Sigmodon averaged 7.5 days in winter, 7.9 days in spring, and means ranged from 7.7 to 8.6 days at the different treatment levels in the laboratory. Laboratory mean values for Reithrodontomys ranged from 3.5 to 3.9 days. For Peromyscus, T/sub b/ values averaged 3.4 days in winter, 3.6 days in spring, and 3.5 days in the laboratory. The data suggested that elimination of ^{59}Fe is influenced by metabolic rates of rodents in the field, but laboratory experiments were unable to demonstrate any predictable relationship. Neither did the rate of final-component ^{137}Cs loss from rodents appear to be influenced by metabolic rate. However, final-component Y-axis intercept values of ^{137}Cs exhibited a linear correlation with metabolic rates, and equations were derived from these intercept values to predict metabolism in the field for two species. (auth)

11639 **Isotopic dilution of zinc-65 in Oregon coastal waters.** Cutshall, N.H.; Renfro, W.C.; Larsen, I.L. (Oregon State Univ., Corvallis). *Health Phys.*; **29**: No. 6, 865-869(Dec 1975).

Specific activity of $^{65}Z(^{65}Zn/Zn)$ observed in mussels, Mytilus californianus, collected along the Oregon coast is compared to values predicted, based on a simple model for isotopic dilution of ^{65}Zn in the Columbia River. The observed values are very similar to those computed from the model. The analysis provides no evidence that chemical speciation of zinc in coastal waters affects the specific activity of mussels. (auth)

11640 **Radioiodine ^{131}I in animal thyroids during nuclear test in both hemispheres.** Van Middlesworth, L. (Univ. of Tennessee, Memphis). *Health Phys.*; **29**: No. 6, 861-863(Dec 1975).

In mid-1974 a small increase of ^{131}I was observed in animal thyroids following a nuclear test in China. In late 1974 there was no public announcement of an atmospheric nuclear test in the Northern Hemisphere, but ^{131}I was readily measured in animal thyroids. This latter increase occurred while animals in the Southern Hemisphere accumulated ^{131}I from nuclear tests in the Southern Hemisphere. It is suggested that in late 1974 the Northern Hemisphere was contaminated by either late fallout from tests in June or by interhemispheric mixing or by a combination of these sources. (auth)

PLANTS

REFER ALSO TO CITATION(S) 11468, 11524, 11625

11641 **Nuclear methods for detecting root activity.** Haahr, V. (Danish Atomic Research Commission, Risoe). pp 57-63 of In Tracer techniques for plant breeding. Vienna; International Atomic Energy Agency (1975).

From Proceedings of tracer techniques for plant breeding; Vienna, Austria (2 Dec 1974).

See STI/PUB—419; CONF-741261—.

Two nuclear methods for evaluating root activity were compared in a field experiment with equally spaced plants of two spring barley genotypes. The ^{32}P and water uptake from different depths were used to evaluate the root activity. The uptake of ^{32}P from a given depth varied considerably more from plant to plant than the dry matter production. It is concluded that the ^{32}P technique is not suitable for selection of single plants of genotypes differing in root activity. Measurements of water uptake from soil profiles with a neutron moisture meter are found to be a useful technique for detection of root activity of plant stands. (auth)

CHEMICALS METABOLISM AND TOXICITY

INVERTEBRATES

REFER ALSO TO CITATION(S) 11475

11642 **Transient behavior of cadmium in a grassland arthropod food chain.** Van Hook, R.I.; Yates, A.J. (Oak Ridge National Lab., TN). *Environ. Res.*; 9: No. 1, 76-83(1975).

Biological assimilation and transport of cadmium were determined for an arthropod food chain in an east Tennessee grassland community. Laboratory experiments demonstrated that there were no significant differences (P greater than 0.05) in assimilation rates (17 percent assimilation per day) or biological half-lives (7 days) of ^{109}Cd either as soluble nitrate or insoluble oxide in crickets under identical conditions. Field experiments demonstrated that primary consumers (crickets) accumulated ^{109}Cd much more rapidly (uptake rate = 0.55 day^{-1}) than did the spider predators (uptake rate = 0.08 day^{-1}). Equilibrium concentrations in crickets were obtained in 9 days (0.04 ppM cadmium), while equilibrium was not reached in spiders during the 30-day study. Food-chain concentration of cadmium did not occur as crickets accumulated levels of cadmium 60 percent of that in their vegetation food sources and spiders accumulated only 70 percent of the cadmium present in the cricket tissues. (auth)

VERTEBRATES

REFER ALSO TO CITATION(S) 11475

MAN

REFER ALSO TO CITATION(S) 11618

11643 (ERDA—93, pp 141-146) **Occupational health experience with uranium in ore processing mills.** Wilde, R.M. (Nuclear Regulatory Commission, Washington, DC). 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

The occupational exposure experience at one large uranium ore processing mill is reviewed. Application of conventional methods of dust control resulted in airborne uranium concentrations that were generally less than 10 percent of the maximum permissible concentration. In-vivo counting of individuals who had been exposed to aerosols that contained daughter-free uranium or to aerosols that contained uranium and daughters indicated that internal deposition and accumulation of measurable amounts of natural uranium, thorium-230, and radium-226 had not occurred after 10 or more years of exposure. (auth)

11644 (ERDA—93, pp 147-159) **Occupational health experience with a contractor uranium refinery.** Heatherton, R.C. (National Lead Co. of Ohio, Cincinnati). 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

This paper presents information related to the occupational exposure of workers in uranium refinery operations at the Feed Materials Production Center since 1958. Included are: a brief history of the FMPC; a description of the operations and the principal sources of exposure; airborne uranium, urinary excretion, in vivo monitoring and tissue analysis data; and some observations regarding the exposure and health status of employees. (auth)

11645 (ERDA—93, pp 160-166) **Health experience in industrial uranium refining operations.** Sinke, G.J.; Grosclaude, C.A. (Kerr—McGee Nuclear Corp., Oklahoma City). 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

A modern process is described for the refining and purification of uranium as yellowcake to uranyl nitrate hexahydrate and its subsequent conversion to uranium hexafluoride. Ventilation control equipment is discussed as utilized at the various process stages. The use of respiratory protective equipment is explained. Health physics data for the year 1974 is given including air sampling, urine sampling, and external radiation exposures. The data presented shows that employee exposure to radiation and airborne radioactive material can be maintained at levels well below permissible limits during uranium refining and conversion operations. (auth)

11646 (ERDA—93, pp 167-184) **Occupational health aspects of a fluoride volatility process.** Freeman, E.J. (Allied Chemical Corp., Morristown, NJ). 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

The Fluoride Volatility process for converting uranium concentrates (U_3O_8) to uranium hexafluoride differs from other processes in that all the steps, except fluorination and distillation, involve handling large volumes of potentially dusty material and that impurities, including daughter products, are not removed until these last steps. The medical and environmental monitoring programs are reviewed and the results summarized, indicating exposures well below the allowable limits. (auth)

11647 (ERDA—93, pp 195-203) **Industrial fuel fabrication operation.** Sanders, C.F.; Bibb, R.D. (Westinghouse Electric Corp., Columbia, SC). 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

The Westinghouse—Columbia Plant Health physics protection programs have been established in accordance with the chemical, physical, and radiological properties of the materials associated with each particular manufacturing area. In the chemical conversion area, air samplers have been located in breathing zone areas associated with various work stations. Urine samples are collected on a weekly basis to determine possible blood level concentrations of transportable uranium compounds. In the case of air samples and bioassays, work restrictions are issued at appropriate pre-determined levels. Fecal samples are required of those personnel working in areas where there is a potential for exposure to nontransportable uranium compounds. In the ceramic and mechanical areas, urine samples are collected on a monthly basis. In both areas, work is performed with non-transportable compounds only. Fecal samples are required of those personnel receiving more than a 6.8 MPC-hour exposure in any one day. Such data provides a useful basis for establishing the adequacy of the air sampling stations which exist throughout the ceramic and mechanical areas. In-vivo counting is performed on all personnel at least on a yearly basis. Those personnel whose in-vivo counts indicate that there may be between 50 to 75 percent of a maximum permissible lung burden are counted on a quarterly basis. Work restrictions are issued on those personnel who exceed 75 percent of a maximum permissible lung burden. External radiation exposures of personnel located in the radiation areas of the plant are monitored using TLD whole-body badges. Badges are collected on a monthly basis. (auth)

11648 (ERDA—93, pp 205-214) **Nuclear Regulatory Commission occupational exposure experience at uranium plants.** Metzger, J.R. (Nuclear Regulatory Commission, Washington, DC). 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

Inspections of Nuclear Regulatory Commission (NRC) licensees are conducted to determine compliance with regulatory requirements. Certain guides, codes and standards are also used as a basis for determining adherence to acceptable standards for radiological safety. The following text describes the experiences NRC inspectors have had in conducting inspections of uranium fuel processing facilities, mills and UF_6 conversion plants. Also in-

cluded is a summary of the most frequently encountered violations of NRC regulatory requirements. This paper describes experiences in several basic areas of concern. These include contamination levels, airborne radioactivity, external radiation exposures, environmental radioactivity and bioassay programs. (auth)

11649 (ERDA—93, pp 225-243) **Review of uranium excretion and clinical urinalysis data in accidental exposure cases.** Boback, M.W. (Naional Lead Co. of Ohio, Cincinnati). 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

This report reviews urinalysis results obtained following four incidents in which thirteen workers were exposed to high concentrations of airborne uranium. The compounds involved were U_3O_8, UF_6, and uranium ore concentrates. Urine samples collected following these exposures were always analyzed for uranium, and in some cases, for specific gravity, pH, protein, sugar, white blood cells, red blood cells, and casts. Although urinary uranium concentrations exceeded 1 mg U/l, no evidence was found to indicate kidney damage as a result of these exposures. (auth)

11650 (ERDA—93, pp 256-261) **Review of the bell study.** Marks, S. (Energy Research and Development Administration, Washington, DC). 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

The Bell Study of the feasibility of conducting an epidemiologic investigation of the health of workers in a few typical uranium feed plants is reviewed here. The investigators concluded that an epidemiologic study, using plant records, would be feasible. The categories of data that were collected are described in this review. Preliminary analyses of data collected on selected groups of workers and comparison groups were performed in the study and are discussed briefly. (auth)

11651 (ERDA—93, pp 297-322) **Uranium in man based on urinary excretion data.** Heid, K.R.; Walsh, W.P.; Houston, J.R. (Battelle Memorial Inst., Richland, WA). 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

Generalized models for making prompt and final evaluations of uranium uptakes and resulting dose commitments to lung and bone using urinary excretion data are presented. Pathways and clearance times developed by researchers and accepted by health physicists are described for Class D, W, and Y compounds of uranium. This includes exponential clearance from the lung to blood and clearance from bone described by a power function equation. Although this paper deals with evaluations using urinary excretion data solely, this practice is not recommended since a better evaluation can be made by combining urinary excretion and in vivo examination data. (auth)

11652 (ERDA—93, pp 387-400) **Occupational radiation exposure experience: Paducah Gaseous Diffusion Plant.** Baker, R.C. (Union Carbide Corp., Paducah, KY). 1975.

From Conference on occupational health experience with uranium; Arlington, Virginia, USA (28 Apr 1975).

In Conference on occupational health experience with uranium.

The potential for significant uranium exposure in gaseous diffusion plants is very low. The potential for significant radiation exposure in uranium hexafluoride manufacturing is very real. Exposures can be controlled to low levels only through the cooperation and commitment of facility management and operating personnel. Exposure control can be adequately monitored by a combination of air analyses, urinalyses, and measurements of internal deposition as obtained by the IVRML. A program based on control of air-borne uranium exposure has maintained the internal dose of the Paducah Gaseous Diffusion Plant workman to less than one-half the RPG dose to the lung (15 rem/year) and probably to less than one-fourth that dose. (auth)

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

REFER ALSO TO CITATION(S) 11585

11653 (BNWL—1973) **Biomagnetic effects: a consideration in fusion reactor development.** Mahlum, D.D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1976. Contract E(45-1)-1830. 27p. Dep. NTIS $5.00.

Fusion as a power source is receiving an increasing amount of attention. Several designs have been proposed and the feasibility of each alternative is being studied. As we move closer to a working design, attention can be paid to potential biological hazards. Large magnetic fields and the emission of tritium and lithium are unique to some fusion reactor designs. The results of a review of the current state of knowledge concerning the biological effects of magnetic fields alone and in combination with ionizing radiation are summarized in this report. The purpose of the review is to help identify areas where additional biomedical research is needed for establishing guidelines for reactor design and operation. 64 references (auth)

11654 (CONF-741182—, pp 174-177) **Biological hazards of exposure to microwave radiation.** Grant, E.H. (Queen Elizabeth Coll., London). 1974.

From Scientific colloquium on medical supervision of workers exposed to ionizing and non ionizing radiations; Brussels, Belgium (28 Nov 1974).

In Scientific colloquium on medical supervision of workers exposed to ionizing and non-ionizing radiations.

The facts concerning the effects of microwave radiation on biological tissue are reviewed and interpreted in terms of hazards to personnel. Areas where controversy still exists are discussed and mention is made of some of the outstanding problems yet to be solved. (auth)

11655 (CONF-741182—, pp 178-189) **Biological risks resulting from the use of lasers.** Miro, L. (Faculte de Medecine de Nimes, France). 1974.

From Scientific colloquium on medical supervision of workers exposed to ionizing and non ionizing radiations; Brussels, Belgium (28 Nov 1974).

In Scientific colloquium on medical supervision of workers exposed to ionizing and non-ionizing radiations.

There is an increasing tendency for laser-based systems to be devised and put into use in metrology, data banks, telecommunications, holography, machining, microelectronics, nuclear research, and medicine. Users have felt concerned about the dangers which might arise from such systems and during recent years many regulations of a more or less official nature have been introduced to deal with the use and installation of lasers. An attempt is made to try to evaluate the health hazards involved. The biological effects of lasers on the eyes and on human skin are reviewed. (CH)

11656 (CONF-741182—, pp 190-210) **Nature of medical examinations of persons working with laser beams.** Renz. (Berufsgenossenschaft der Feinmechanik und Elektrotechnik, Cologne). 1974.

From Scientific colloquium on medical supervision of workers exposed to ionizing and non ionizing radiations; Brussels, Belgium (28 Nov 1974).

In Scientific colloquium on medical supervision of workers exposed to ionizing and non-ionizing radiations.

Wherever people are exposed to particular health hazards in connection with their occupations, industrial medical precautions must be taken. This principle also applies to the use of laser beams, a branch of modern technology which is still in the process of development. Lasers are sources of intense sharply focused radiation in the visible band or the invisible infra-red or ultra-violet regions of the spectrum. The effect produced by lasers, if one discounts extremely brief and highly intensive irradiation, is mainly one of heat. In short, laser injuries are usually localised burns. The main danger caused by laser beams is to the eyes. One must distinguish between radiation capable of penetrating the eye and radiation which is absorbed in the outer layers of the cornea. Because of the special physical properties of laser radiation, the beam which was already well focused can be extremely sharply focused on the retina. The size of the retinal image is limited only by diffraction. In extreme cases, the intensity of the beam may thus be increased more than a hundred thousand fold. The eyeground may therefore be injured by radiation of relatively low intensity. Injury to the eyeground, and especially to the retina may range, according to radiation intensity, from very slight damage to limited groups of cells to rare cases of devastation of portions of the eye. (auth)

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 10839, 11438, 11654, 11655, 11656

11657 (BNWL—1971) **SNS source term evaluation program.** Craig, D.K.; Cannon, W.C.; Filipy, R.E.; Powers, G.J.; Dionne, P.J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1976. Contract E(45-1)-1830. 60p. Dep. NTIS $5.50.

Plutonium-238 is currently used in the form of a pure refractory oxide as a power source on a number of space vehicles that have already been or will be launched during the next few years. Results are reported on aerosol experimental studies, that concern interactions between soils and $^{238}PuO_2$ aerosols which might be created in a space launch abort environment; marine animal studies, which concern support activities for the SNS underwater experiments; ultrafilterability studies, concerns in vitro solubility tests of $^{238}PuO_2$ as a function of time, temperature, suspension concentration, and molality of solvent; and mathematical modeling, which concerns support of the SNS safety effort to standardize analytical techniques for system risk analysis, including the modeling or biological data obtained from inhalation exposure of rodents and dogs to $^{238}PuO_2$ aerosols and comparison of the models to that developed for $^{239}PuO_2$. (CH)

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

COSMIC RADIATION

REFER ALSO TO CITATION(S) 11674, 12053

11658 (CONF-730804—P3, pp 2007-2012) **Project of an arrangement for the detection of neutrino radiation from collapsing stars.** Chudakov, A.E.; Ryajskaya, O.G.; Zatsepin, G.T. (Inst. for Nuclear Research, Moscow). 1973.

From 13. international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A scintillation counter containing 100 tons of liquid scintillator is mounted in a salt mine at a depth of about 700 m.w.e. The scintillator of this counter will be viewed by 128 photomultiplayers with 15 cm diameter of photocathode. The collapse of a star in the center of our galaxy can be detected if neutrino radiation energy is about 10^{52} ergs. (auth)

STARS

REFER ALSO TO CITATION(S) 11658, 12051, 12059

11659 (ESRO-SP—106, pp 1-10) **Cosmic gamma-ray bursts: a review of the observational data.** Strong, I.B. (Los Alamos Scientific Lab., NM). Nov 1974.

From ESLAB symposium on the context and status of gamma-ray astronomy; Frascati, Italy (10 Jun 1974).

In Context and status of gamma-ray astronomy.

This paper is intended as a general introduction to the session on transient cosmic x- and gamma-ray sources—gamma bursts. Temporal properties will be discussed first, including duration, fluctuation, and frequencies. Energy fluxes and spectral properties are then described together. Finally, the directional data are used to provide estimates of the distance to the sources and the absolute luminosities involved. (auth)

11660 (ESRO-SP—106, pp 69-76) **Future satellite experiments for gamma-burst observations.** Evans, W.D. (Los Alamos Scientific Lab., NM). Nov 1974.

From ESLAB symposium on the context and status of gamma-ray astronomy; Frascati, Italy (10 Jun 1974).

In Context and status of gamma-ray astronomy.

Based on the presently available data, certain objectives for future satellite experiments are identified. Methods for achieving these objectives and the requirements they impose on instrument design and program coordination are described. Some of the experiments planned for launch during the next few years are discussed and the extent to which they will satisfy the objectives is considered. (auth)

11661 **Neutron stars.** Baym, G.; Pethick, C. (Univ. of Illinois, Urbana). *Annu. Rev. Nucl. Sci.*; **25**: 27-77(1975).

Recent developments in the understanding of the properties of condensed matter at high densities and their implications for the structure of neutron stars are reviewed. Topics include nuclear physics of the crust, neutron star interiors, transport properties, and neutron star models. 231 references. (BJG)

11662 **Absorption and defocusing of electromagnetic radiation by a Schwarzschild black hole.** Haxton, W.; Ruffini, R. (Institute of Theoretical Physics, Stanford University, Stanford, California 94305). *Ann. Phys. (N.Y.)*; **95**: No. 1, 1-9(Nov 1975).

A comparison of electromagnetic radiation absorbed by a black hole and that emitted at infinity is made for selected circular orbits of a charged particle in a Schwarzschild geometry. Radiation intensity and beaming processes for geodesic as well as ultrarelativistic unbound orbits are compared and contrasted with the special relativistic results of classical electrodynamics. (AIP)

11663 **Leptonic-decay distributions for heavy-lepton pairs produced by colliding beams.** Pi, S.; Sanda, A.I. (Department of Physics, The Rockefeller University, New York, New York 10021). *Phys. Rev. Lett.*; **36**: No. 1, 1-4(5 Jan 1976).

A general differential cross section is presented, in the colliding-beam rest frame, for μe-pair production by leptonic decays of a heavy spin-1/2 lepton pair, themselves assumed to be produced via one-quantum annihilation. Our results hold for general, V,A,S,T,P couplings and depend neither on the μe-universality assumption nor on the absence or presence of neutral-current effects. Distributions relevant to the events reported by a Lawrence Berkeley Laboratory-Stanford Linear Accelerator Center group are presented. (AIP)

QUASI-STELLAR, RADIO, AND X-RAY SOURCES

REFER ALSO TO CITATION(S) 11659

11664 **Radiation pressure in quasar clouds.** McKee, C.F.; Tarter, C.B. (Physics and Astronomy Departments, University of California, Berkeley). *Astrophys. J.*; **202**: No. 2, 306-318(1 Dec 1975).

The effects of ionizing radiation pressure on optically thick clouds are analyzed and the results applied to quasars. An analysis shows that the radiative acceleration of a cloud is approximately-greater-than10 percent of the fully optically thin value unless the continuum optical depth is very large. The acceleration produced by line absorption is confined to the face of the cloud which is exposed to the incident flux, while the acceleration due to the continuum radiation increases inside the cloud. The disruptive effect of internally created line photons, originally studied by Williams, is analyzed for the case of an optically thick continuum, and it is found that the disruptive acceleration can be greatly enhanced and that it is anisotropic tending to blow off the back side of the cloud. Hence it is concluded that if quasar clouds are radiatively accelerated, they are optically thin; and it is shown that this result is consistent with the observations. Confinement of the clouds is discussed, and it is shown that photoionized clouds cannot be confined by radiation pressure alone. A model for absorption lines produced by numerous small clouds is developed, and it is argued that the absorption lines most likely arise outside the emission-line region. (AIP)

SOLAR PHENOMENA

11665 (COM—75-50193-366-S/SL) **Solar—Geophysical Data number 366 (supplement), February 1975. Explanation of data reports.** (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Feb 1975. 89p. (SGD—366(Suppl.)). Paper copy available from National Climatic Center, Attn: Publications. Federal Bldg., Asheville, N.C. 28801. Subscription $34.50/year includes Part 1 (Prompt Reports) and Part 2 (Comprehensive Reports); $18.00/year for either part. Annual supplement containing explanation is included. $1.40/copy for either part; $1.30 for this extra issue.

See also COM—75-50193-366-1 and COM—75-50193-366-2.

This publication contains the description and explanation of the data contained in the monthly publication Solar—Geophysical Data issued by the Environmental Data Service of NOAA. The data are intended to keep research workers abreast on a timely schedule of the major particulars of solar activity and the associated interplanetary, ionospheric, radio propagation and other geophysical effects. Data interpreted include alert periods, daily solar indices, solar flares, solar radio waves, solar x-ray radiation, solar wind measurements, solar proton monitoring, interplanetary magnetic and electric fields, solar proton events, solar activity centers, sudden ionospheric disturbances, cosmic rays, geomagnetic activity, radio propagation indices, reduced magnetograms, and flare index by region. An index to volumes for 1957—1974 is included. (GRA)

11666 **2.2 MeV and 0.51 MeV gamma-ray line emissions from solar flares.** Wang, H.T. College Park, MD; Univ. of Maryland (1975). 106p. University Microfilms Order No. 75-28,942.

Thesis (Ph. D.).

The formation of the 2.2 MeV and 0.51 MeV gamma-ray lines from solar flares is calculated and the results are compared with observations of the August 4 and 7, 1972 flares. For the 2.2 MeV line, a Monte-Carlo method is used for neutron and 2.2 MeV photon propagation in solar atmosphere, taking into account escape, decay and loss on ^{3}He for neutrons, and Compton scattering for 2.2 MeV photons. For the 0.51 MeV line, the full energy spectrum of positrons from π^+ decay, the slowing-down process of positrons, the mean life of β^+ emitting nuclei and the annihilation and positronium formations of the positrons in the ambient medium were taken into account. The width of the 2.2 MeV line is very narrow and is not broadened by the Doppler and Compton effects. For an isotropic release of neutrons, the 2.2 MeV photon yield per neutron is between about 0.05 to 0.02 provided that the flare is not too close to the solar limb and the photospheric ^{3}He/H ratio is less than 5×10^{-5}. The time lags between the nuclear reactions and the formation of the 2.2 MeV and 0.51 MeV lines are caused respectively, by capture of the neutrons, and by deceleration of the positrons and decay of the radioactive nuclei. The lag can explain the delayed gamma-ray emission on August 7. Positrons of energies greater than about 10 MeV could be detected in interplanetary space following large solar flares. (Diss. Abstr. Int., B)

11667 Solar wind heavy ion abundances. Bame, S.J.; Asbridge, J.R.; Feldman, W.C.; Montgomery, M.D. (Los Alamos Scientific Lab., N.Mex. (USA)); Kearney, P.D. (Colorado State Univ., Fort Collins (USA)). *Sol. Phys.*; 43: No. 2, 463-473(Aug 1975).

During periods in 1969-1971 when interplanetary flow conditions were quiet, 17 determinations of the solar wind Fe and Si abundances and 7 of the O abundance were made. On the average $[N(Fe)/N(H)] = 5.3 \times 10^{-5}$, $[N(Si)/N(H)] = 7.6 \times 10^{-5}$ and $[N(O)/N(H)] = 5.2 \times 10^{-4}$. Variations from the averages over a total range of factors of approximately 4 for O, approximately 4 for Si, and approximately 10 for Fe have been observed. Although Fe and Si abundance variations appear to be correlated, no other element correlation pairs are unambiguously discernible from the present data set. (NL)

GALAXIES

11668 Exact solution of the Lifshitz equations governing the growth of fluctuations in cosmology. Adams, P.J.; Canuto, V. (Institute for Space Studies, National Aeronautics and Space Administration, New York, New York 10025). *Phys. Rev., D;* 12: No. 12, 3793-3799(15 Dec 1975).

The exact solution of the Lifshitz equations governing the cosmological evolution of an initial fluctuation is presented. Lifshitz results valid for c/subs/^{2} = 0 and c/subs/^{2} = 1/3 are extended in closed form to any equation of state of the form p = c/subs/$^2\epsilon$. The solutions embody all the results found previously for special cases of c/subs/^{2}. It is found that the growth of any initial fluctuation is only like t/subn/ with n < or = 4/3 and hence insufficient to produce galaxies unless the initial fluctuation is very large. A possible way to produce very large initial fluctuations by modifying the equation of state by including gravitational interactions, as originally suggested by Sakharov, is also examined. It is found that a phase transition can occur at baryonic density of 1 nucleon per cubic Planck length, or equivalently at a time $t \cong 10^{-43}$ sec. At those early times the masses allowed by causality requirements are, however, too small to be of interest in galaxy formation. (AIP)

COSMOLOGY

REFER ALSO TO CITATION(S) 10955, 11236, 11668

11669 Hamiltonian treatment of a quantum scalar field in a Bianchi I universe. Pessa, E. (Univ., Rome). *Lett. Nuovo Cim.*; 15: No. 9, 295-299(28 Feb 1976).

It is shown that with the aid of an Hamiltonian formalism, which is developed, it is possible to treat the problem of a quantum scalar field in a Bianchi I universe of a given metric, taking into account the reaction of the scalar field on the metric itself. Some preliminary calculations show that the process of particle creation, treated within the context of this formalism can account for a large part of the matter content of the universe; it is hoped that subsequent calculations can aid in the problem of the dissipation of the initial anisotropy of the universe. (JFP)

PLANETARY PHENOMENA

11670 Pioneer 10 plasma analyzer results at Jupiter. Wolfe, J.H. (National Aeronautics and Space Administration, Moffett Field, Calif. (USA). Ames Research Center). pp 279-296 of In Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From Symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

The principal scientific objectives of Pioneer 10 are to investigate the nature of the interplanetary medium beyond the orbit of Mars, including the asteroid belt, and to make direct, in situ, observations of the planet Jupiter and its environment. successful flyby of Jupiter by Pioneer 10 achieved the latter objectives; however, the interplanetary objectives are still being pursued in the present post-encounter mission beyond Jupiter. Present estimates are that the Pioneer 10 spacecraft can be utilized for interplanetary observations to a solar radial distance of at least 20 AU. (NL)

11671 Development of the mare regolith: some model considerations. Quaide, W.; Oberbeck, V. (National Aeronautics and Space Administration, Moffett Field, Calif. (USA). Ames Research Center). *Moon;* 13: No. 1-3, 27-55(May 1975).

Mare regolith is fragmental debris of variable thickness that lies upon fractured bedrock. Its origin by impact comminution of primarily local basaltic rocks is widely accepted, but the consequences of such an origin are not appreciated fully. This investigation uses results obtained in an earlier Monte Carlo study by Oberbeck et al. (1973) to shed light on those consequences by evaluating regolith growth and mixing as a function of time. Results reported are for average cases and must be used with caution. The study demonstrates that regolith growth is self regulated and has the same trend and nearly the same terminal growth rates whatever the history of bombardment: rapid initial accumulation followed by diminishing rates of growth. Mixing and all other processes investigated are growth regulated. Mixing increases as growth slows, but never to the extent that the regolith is homogenized. Because the average regolith is never homogenized, products of growth regulated processes are preserved in the stratigraphy. Differences in material properties are to be expected in vertical sections of the regolith, therefore, this model is not sufficiently refined to permit prediction of all possible trends. It does indicate, however, that deeper levels contain thinner depositional units, lesser quantities of meteoritic and exotic components, and more debris derived from shallow levels in the mare basalts than material in near surface layers. Additionally, neutron fluence production is regulated by the growth process, but because rates of growth do not differ much over the last aeon, whatever the total age or early bombardment history, values of surface fluence may be similar in many areas whatever their age. (NL)

11672 Stratification in the lunar regolith: a preliminary view. Duke, M.B. (NASA Johnson Space Center, Houston, Texas, USA); Nagle, J.S. (Northrop Services Inc., Houston, Texas, USA). *Moon;* 13: No. 1-3, 143-158(May 1975).

Although the knowledge of lunar regolith stratification is incomplete, several categories of thick and thin strata have been identified. Relatively thick units average 2 to 3 cm in thickness, and appear surficially to be massive. On more detailed examination, these units can be uniformly fine-grained, can show internal trends, or can show internal variations which apparently are random. Other thick units contain soil clasts apparently reworked from underlying units. Thin laminae average approximately 1mm in thickness; lenticular distribution and composition of some thin laminae indicates they are fillets lined from adjacent rock fragments. Other dark, fine-grained, well-sorted thin laminae appear to be surficial zones, reworked by micrometeorites. Interpretations of stratigraphic succession can be strengthened by the occurrence of characteristic coarse rock fragments and the orientation of large spatter agglutinates, which are commonly found in their original depositional orientation. (NL)

ATMOSPHERIC PHYSICS

AURORAL AND IONOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 11764, 12103

11673 (AD/A—009340) **Data reduction and auroral characterizations for ICECAP. HAES report No. 4. Final report, 17 August 1972—17 August 1974.** Kofsky, I.L.; Meriwether, J.W. Jr.; Schroeder, J.W. (Photometrics, Inc., Lexington, Mass. (USA)). 17 Sep 1974. Contract DNA001-73-C-0027. 338p. (PhM—110-74). NTIS $9.50.

This is a report on PhotoMetrics' contributions to the Infrared Chemistry Experiments—Coordinated Auroral Program in the period 17 Sep 72—17 Aug 74. It presents ICECAP rocket and ground support data reduced and partially analyzed, procedures and computer programs for further application of program data to understanding radiations from the artificially-disturbed atmosphere, characterizations of the auroral ionosphere into which the rocket experiments were launched and critiques of the instruments, background information for planning related coordinated aurora experiments, and some interpretation of program results. (GRA)

11674 (CONF-730804—P3, pp 2021-2031) **Cosmic ray neutrino-induced muon spectrum and the inelastic neutrino cross section at high energies.** Bergeson, H.E.; Cassiday, G.L.; Hendricks, M.B. (Univ. of Utah, Salt Lake City). 1973.

From 13. international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The results of a measurement of the integral energy distribution of the neutrino-induced muon flux deep underground using the Utah neutrino detector are reported. By comparing the observed and expected distributions, lower limits are set on the saturation energy E_0 of the total neutrino-nucleon cross section or, equivalently, on the mass M/sub w/ of the intermediate vector boson if scale invariance of the inelastic structure function νW_2 is assumed. At the 1, 2, and 3 sigma levels of confidence M/sub w/ is greater than 8.5, 4.5, 2.8 GeV or E_0 is greater than 230, 165, 25 GeV respectively. (auth)

11675 (PB—238839) **Report of NRL progress.** (Naval Research Lab., Washington, D.C. (USA)). Oct 1974. 54p. NTIS $4.25.

Research at NRL on theoretical and numerical simulation studies of ionospheric irregularities are reviewed under the following headings: antennas, electronics, metallurgy, ocean sciences, ocean technology, optical radiation, radar, and space science. Papers and patents by NRL staff members are listed. (GRA)

11676 (UCRL—77403) **Posteriori restoration of atmospherically degraded images using multiframe imagery.** Sherman, J.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jan 1976. Contract W-7405-eng-48. 12p. (CONF-760206—2). Dep. NTIS $3.50.

From The topical meeting on image processing; Pacific Grove, California, United States of America [USA] (24 Feb 1976).

The presence of atmospheric turbulence degrades the angular resolution attainable using conventional photographic methods with an astronomical telescope. Near diffraction-limit resolution has been obtained using statistical measurements from short exposure photographs by Labeyrie. A signal processing method for the A posteriori restoration of atmospherically degraded images is developed. The emphasis is on near "optimal" processing of the measurements so that the images are restored without enhancing the unwanted noise effects. Short exposure images are used to "freeze" the motion caused by atmospheric turbulence. Multiframe imagery is used to obtain first and second order statistics of the degraded images. The integral equations relating the measured statistics to the underlying object and atmospheric characteristics are derived. A multi-step process is developed for solving these integral equations. An estimate of the Cartesian product of the object with itself is obtained from the second order statistics using Fourier methods. An estimate of the object is then derived from an eigen expansion of the Cartesian product. This estimate is augmented by an estimate from the first order statistics. The performance of this restoration method is illustrated by simulation results. (auth)

11677 **Global ozone balance in the natural stratosphere.** Johnston, H.S. (Univ. of California, Berkeley). *Rev. Geophys. Space Phys.*; 13: No. 5, 637-649(Nov 1975).

The method of instantaneous rates is a three-dimensional model that takes the observed distribution of atmospheric species and temperature as input data. The distribution of radiation over wavelength, photochemical rate constants, and reaction rates are evaluated in each cell of the three-dimensional grid. For certain problems of restricted scope, definite answers can be given by this approach. For example, it is shown that the Chapman reactions and air motions are insufficient to give a global ozone balance; these factors account for only about 20 percent of the ozone produced below 45 km. There must be other photochemical or chemical reactions that destroy natural stratospheric ozone. The water reactions (H, HO, and HOO radicals) balance about 10 percent of the ozone produced below 45 km. Recently observed concentrations of nitrogen dioxide at up to 36-km elevations are close to those required to destroy the remaining 70 percent of naturally produced ozone. Until enough measurements are made to characterize the vertical, latitudinal, and seasonal distribution of nitrogen dioxide, it will not be known whether yet other substances (such as chlorine, bromine, and metallic oxide particles) play a significant (10 percent or more) role in the natural ozone balance. (auth)

EFFECTS OF NUCLEAR DETONATIONS

11678 (LA—6068-MS) **Geomagnetic radioflash unfold (GRUF).** Malik, J.S. (Los Alamos Scientific Lab., N.Mex. (USA)). Aug 1975. Contract W-7405-eng-36. 4p. Dep. NTIS $4.50.

A method of inverting the geomagnetic component of the radioflash signal from a nuclear explosion to obtain the gamma-ray time history was proposed by E. D. Dracott of the Atomic Weapons Research Establishment. A simplified development of an elaboration by B. R. Suydam has been programmed for small calculators in a form suitable for interim field analysis of such data. The development of the program is contained in the report. (auth)

MAGNETOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 11665

11679 **Hot-cold plasma interactions in the Earth's magnetosphere.** Williams, D.J. (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA)). pp 161-177 of In Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From Symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

A synopsis of observations and results obtained from the Explorer 45 satellite which pertain directly to the interaction of the magnetospheric hot and cold plasma populations is presented. Explorer 45(S^3) was launched on November 15, 1971 into an elliptical orbit having an apogee of 5.24 R/sub E/, a perigee of 220 km, a period of 7.82 h and an inclination of 3.5°. An electrostatic analyzer-channeltron instrument plus three separate solid state detector systems measure proton intensities from 0.73 keV to 872 keV in 28 energy steps and electron intensities from 0.73 keV to 560 keV in 20 steps. This report considers only the proton data. (NL)

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

REFER ALSO TO CITATION(S) 10955

BEAMS AND THEIR REACTIONS

11680 (CONF-751048—5) **Preliminary evaluation of a modified Mueller—Hortig geometry negative ion source using a negative ion source test facility.** Alton, G.D. (Oak Ridge National Lab., Tenn. (USA)). 1975. 6p. Dep. NTIS $3.50.

From International conference on heavy ion sources; Gatlinburg, Tennessee, USA (27 Oct 1975).

A negative sputter-type ion source of the Mueller-Hortig geometry is described which utilizes a positive surface ionization source. Among the ion beams which have been produced are: Al$^-$-0.2 μA; AlI0$^-$-3 μA; Au$^-$-6 μA; C$^-$-25 μA; C_2^--20μA; Cl$^-$-100 μA; Cu$^-$-0.5 μA; CuO$^-$-0.8 μA; F$^-$-40 μA; I$^-$-26 μA; O$^-$-30 μA; Pt$^-$-3 μA; S$^-$-44 μA; TaO_2^--2 μA. The yields of Cl$^-$, F$^-$, O$^-$, and S$^-$ produced from gaseous or high vapor pressure compounds are observed to be sensitively dependent on the metallic surface from which they are generated, indicating an intermediate surface chemical effect. While the source produces very intense beams of the halogens, sulfur, and oxygen and relatively intense beams of the metallic oxides, there appears to be a need for additional surface cesium to ensure maximum negative ion yields from many of the elemental materials. (auth)

11681 (COO—2425-3) **Study of electron and uv photon surface interactions. Progress report, March 1, 1975—February 28, 1976.** Lichtman, D. (Wisconsin Univ., Milwaukee (USA)). Nov 1975. Contract AT(11-1)-2425. 10p. Dep. NTIS $3.50.

A report is given of progress in investigations on electron induced desorption, the photodesorption process, and the development of a critical review on both electron and photon induced desorption, especially as they relate to the controlled thermonuclear research program. (GHT)

11682 (LA—6019) **Negative ion beam processes.** Hayward, T.D.; Lawrence, G.P.; Bentley, R.F.; Malanify, J.J.; Jackson, J.A. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1975. Contract W-7405-ENG-36. 31p. Dep. NTIS $5.00.

Los Alamos Scientific Laboratory fiscal year 1975 work on production of intense, very bright, negative hydrogen (H$^-$), ion beams and conversion of a high-energy (a few hundred MeV) negative beam into a neutral beam are described. The ion source work has used a cesium charge exchange source that has produced H$^-$ ion beams greater than or equal to 10 mA (about a factor of 10 greater than those available 1 yr ago) with a brightness of 1.4 x 10^9 A/m^2-rad^2 (about 18 times brighter than before). The high-energy, neutral beam production investigations have included measurements of the 800-MeV H$^-$-stripping cross section in hydrogen gas (sigma/sub -10/, tentatively 4 x 10^{-19} cm^2), 3- to 6-MeV H$^-$-stripping cross sections in a hydrogen plasma (sigma/sub -10/, tentatively 2 to 4 x 10^{-16} cm^2), and the small-angle scattering that

results from stripping an 800-MeV H^- ion beam to a neutral (H^0) beam in hydrogen gas. These last measurements were interrupted by the Los Alamos Meson Physics Facility shutdown in December 1974, but should be completed early in fiscal year 1976 when the accelerator resumes operation. Small-angle scattering calculations have included hydrogen gas-stripping, plasma-stripping, and photodetachment. Calculations indicate that the root mean square angular spread of a 390-MeV negative triton (T^-) beam stripped in a plasma stripper may be as low as 0.7 μrad. (auth)

11683 (LBL—3399(Suppl.)) **Proceedings of the second symposium on ion sources and formation of ion beams, Berkeley, California, 22—25 October 1974.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1974. 402p. (CONF-741019—). Dep. NTIS $12.00.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

Topics covered include: ion source discharges; extraction and formation of beams; new types of ion sources; negative ion sources I-polarized ion sources; heavy ion sources; high-current multiple-aperture ion sources; applications of ion sources in science and technology; negative ion sources II; and a supplement of 4 papers. Of the 13 invited papers and 61 contributed papers, abstracts of 9 have appeared previously in NSA; and abstracts of 53 appear separately in this issue of NSA and ERA. (GHT)

11684 (LBL—3399(Suppl.), pp I.1.1-I.1.12) **Oscillations in ion-source discharges and their relation to ion beam properties.** Lejeune, C. (Institut d'Electronique Fondamentale, Orsay, France). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

Strong fluctuations are commonly observed in discharge-ion sources. They are correlated to the deterioration of the source properties such as power and gas efficiency, and beam transport and focus. The improvement of source performance requires a reduction of the fluctuation level. Therefore it is necessary to get more insight in the mechanisms which may drive instabilities and to find the conditions either for their stabilization or elimination. These two aspects of the problem of stability are considered in the case of the main instabilities which affect the different parts of a discharge: the circuit, the sheaths, and the plasma. In the case of the plasma, microinstabilities and macroinstabilities are examined separately, as most usual source discharges appear to be magnetohydrodynamically unstable. The experimental results concerning the effects of instabilities on source properties are summarized. 90 references. (auth)

11685 (LBL—3399(Suppl.), pp I.9.1-I.9.6) **Self-crossed field ion sources.** Takagi, T. (Kyoto Univ.); Yamada, I.; Kunori, M.; Kobiyama, S. 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

To obtain an intense ion beam from various kinds of materials, a new PIG type ion source without external magnetic field has been designed and operating characteristics have been studied. In an ordinary type of ion source, voltages are applied to electrodes such as the anode, filament, and extractor under the crossed magnetic field. If a spiral filament or anode is used and heavy DC current flows through the electrode keeping the potential relationship between the filament, anode, and extractor electrodes constant, a magnetic field due to the heavy current can be used effectively for the ionization of materials. Since the magnetic field produced by the electrode system is crossed with an electric field, a new PIG type ion source is obtained which may be called a self-crossed field ion source. Basically, two types of the self-crossed field ion source are proposed. One is the outer filament coil type in which the crossed field is constructed from filament current; the other is an outer helical anode type constructed from spiral anode current. Since the self-crossed ion source has a simple and compact structure without an external magnetic coil, the source is suitable to operate under high temperature and to introduce microwave or RF power. To get an intense ion beam, these ion source units can operate in parallel. Therefore, many new application fields can be expected. (auth)

11686 (LBL—3399(Suppl.), pp III.2.1-III.2.6) **Beam-plasma type ion source for high-intensity ion beam.** Takagi, T.; Yamada, I.; Ishikawa, J.; Sano, F.; Kusano, N. (Kyoto Univ.). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

In a beam-plasma type ion source, the gas is effectively ionized by the microwave power (2 to 20 GHz) transferred from an electron beam through beam-plasma interactions, which are the interactions between the magnetically focused electron beam injection from the ion extractor and the plasma in the drift tube. A high-density and stable plasma is obtained in the drift tube by this beam-plasma discharge because of the microwave heating ionization and the feedback phenomenon which keeps the plasma density constant. When ions are extracted from the high-density plasma produced in the drift tube, they are accelerated in the opposite direction of the electron beam by the same electric field that accelerates the electron beam, and the space charge of the ion beam is highly neutralized by the injected electron beam near the ion extractor. Therefore, a high-intensity and well-confined ion beam is obtained. Moreover, although the extracted ion current increases, the emittance of the ion beam is kept low because of ions trapped in the negative-potential well induced by the electron beam near the ion extractor. (auth)

11687 (LBL—3399(Suppl.), pp VI.4.1-VI.4.5) **Ion source with low voltage extraction using glow discharge.** Kiyama, H. (Ministry of International Trade and Industry, Tokyo). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

Experimental results are given for a new type of plasma source and for the beam efficiency of a multi-aperture three-electrode extraction system at energy 500 to 1000 eV. This plasma source consists of a thin grid in front of a cathode and of a large cylindrical anode mounted close to the extraction electrode. High density, highly ionized, large uniform plasma is produced by glow discharge even with low discharge current. The plasma diameter (2 to 4 cm in diameter) is controlled by the position of line cusp field near the cathode. The densities of hydrogen plasma and argon plasma are more than 10^{12}/cm^3 and more than 10^{13}/cm^3, respectively. The temperatures of the plasmas are about 2 to 3 x $10^{4\circ}$K. This source is operated steady state at 0.5 A with ion energy of 0.5 to 1 keV. The multi-aperture electrodes are of copper 0.5 mm thick and 4 cm in diameter. 400 apertures are made by the photo-etching method. The extraction electrode is recessed. The ratio r/d of the radius of extraction aperture to the distance between the positive and negative electrode is varied. At an optimum ratio r/d the electrical efficiency is about 90 percent and the divergence of the beam is 5° in low ion beam current (about 150 mA). But in higher ion beam current (about 250 mA) the efficiency decreases. (auth)

11688 (LBL—3399(Suppl.), pp VII.1.1-VII.1.8) **Ion beams and material technology.** Rose, P.H. (Extrion Corp., Gloucester, MA). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

The types of ion beams required for material technology such as analysis of surfaces and implantation of semiconductors are identified. Improvement in brightness, without sacrifice of total current, would have a strong effect on the economics of application of ion beams in the lower current ranges. For a large scale process such as the production of corrosion resistant steel sheet, ampere currents of heavy ions are needed. Sources of this type have not yet been constructed although they are possible in principle. (auth)

11689 (LBL—3399(Suppl.), pp VII.4.1-VII.4.6) **Vapourized metal cluster non source for high intensity ion beam applications.** Takagi, T. (Kyoto Univ.); Yamada, I.; Kunori, M.; Kobiyama, S. 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

A new type of ion source with intense equivalent current has been developed. In the source, an ionized vapor aggregate (cluster) is used instead of atomic or molecular ions in ordinary ion sources. A cluster consisting of 10^2 to 10^3 atoms is formed by adiabatic expansion due to the ejection into a high vacuum region through the nozzle of a heated crucible. The clusters are ionized by electron bombardment and accelerated toward a target. The fundamental considerations on the formation and the ionization of clusters have been studied. Applications of cluster ions in industry, such as film formation, are described and fundamental effects of the formation of deposited films have been analyzed. (auth)

11690 (LBL—3399(Suppl.), pp VII.6.1-VII.6..5) **Small diameter negative ion probe.** Purser, K.H.; Hanley, P.R.; Liebert, R.B. (General Ionex Corp., Ipswich, MA). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

A small diameter ion probe has been designed for use in surface analysis systems. The probe uses a duoplasmatron with a fixed offset to produce a negative oxygen beam. The source is bakeable, featuring gold and ceramic-to-metal seals. A dual electrostatic lens system and velocity filter focuses the beam to a spot smaller than 30 μm and a prototype has produced an output current of one microampere of O^- in less than 100 μm diameter. The system has independently adjustable extraction and beam energies and the beam spot size is adjustable. (auth)

11691 (LBL—3399(Suppl.), pp VII.7.1-VII.7.5) **Hollow cathode duoplasmatron for reactive gas ions.** Roden, H.J. (Applied Research Labs., Goleta, CA). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

A duoplasmatron using a hollow cathode rather than a head cathode has been developed for a series of instruments. These instruments use a primary ion beam to bombard a sample and create secondary ions that are subsequently mass analyzed. The composition of an unknown sample can then be determined by the mass spectra produced by such an instrument. Some of the requirements of an ion source for this application are (1) high brightness at less than 20 keV, (2) low energy spread to reduce the chromatic aberration of the primary beam, (3) low gas flow rates so that differential pumping may be avoided, and (4) the ability to generate positive and negative ions from reactive gases. (auth)

11692 (LBL—3399(Suppl.), pp VII.8.1-VII.8.4) **Versatile ion source manifold and rapid ion beam interchange.** Wilson, R.G. (Hughes Research Labs., Malibu, CA). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

Experimental results of rapid switching among ion species in an ion source and high voltage beam system are reported. Times of 1.5 to 6 min were required to switch from full beam current of any one of several ions to any other one of the ions with essentially no waiting for equilibration and little interference from ion species in each new ion beam resulting from prior operation. The ion source manifold used to achieve these results is described. The ions B^+ P^+, As^+, and S^+ were selected for the experiment to be representatively difficult. The total beam currents were about 0.5 mA. (auth)

11693 (LBL—3399(Suppl.), pp VIII.1.1-VIII.1.6) **Surface: plasma source of negative ions.** Belchenko, Yu.I.; Dimov, G.I.; Dudnikov, V.G. (Inst. of Nuclear Physics, Novosibirsk, USSR). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

A powerful source of negative ions with the gas discharge chamber of planotron geometry is described which gives an H^- beam with the current density in the emission slit up to 3.7 A/cm^2 due to intense secondary negative ion emission from the cathode surface, bombarded by the fast discharge particles. The emitted ion beam intensity is nearly proportional to the emission slit surface. The source with the emission slit of 0.9 x 30 mm^2 yields a negative ion beam of 0.88 A with accompanying electron load not more than 1.7 A. (auth)

11694 (LBL—3399(Suppl.), pp VIII.8.1-VIII.8.6) **Contact ionization negative ion source.** Zuccaro, D.E.; Dulgeroff, C.R. (Hughes Research Labs., Malibu, CA). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

A high brightness contact ionization source of negative iodine ions has been developed for use in an ion beam microprobe mass analyzer. The contact ionization process was selected instead of the conventional electron attachment technique because of the small ion energy spread, the low gas load, and the high efficiency of the contact source. The source is a planar LaB_6 cathode which is mounted in a modified Pierce ion optics geometry. A molecular beam of iodine vapor is directed toward the cathode surface. The negative ions and electrons emitted from the surface are accelerated and focused into a narrow beam. A transverse electromagnetic field is used to separate the ion and electron fractions. Ion current densities of 5 to 10 mA/cm^2 were generated at cathode temperatures of 1650 to 1775°K. The electron-to-ion ratios were on the order of 100 to 300. Ionization efficiencies of 5 to 45 percent were observed in this temperature range. The ion source was operated at a brightness level estimated to be 100 A/ cm^2-sr at 10 kV. (auth)

11695 (LBL—3399(Suppl.), pp I.6.1-I.6.5) **Study of the oscillations in reflex-arc ion source plasma and its influence on extracted beam transversal dispersedness.** Kulygin, V.M. (I. V. Kurchatov Inst. of Atomic Energy, Moscow). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

Ion source reflex-arc plasma oscillations are investigated. It is found that frequencies of most intensive oscillations in discharge plasma take place in the range from 50 kc to 1 Mc. These oscillations are caused by rotating disturbances and may be divided into two kinds. The first kind of oscillations take place if neutral hydrogen pressure in the discharge chamber is relatively small. According to its main characteristics these oscillations can be identified as a drift-dissipative instability, modified by rotation in crossed electric and magnetic fields. The second kind of oscillations takes place when charged particle-neutral collision frequencies become quite big. The most probable reason for these oscillations is instability, rising from difference between ion and electron "friction" against a neutral gas. The main working pressure range where ion beam was extracted, was that where the first kind of oscillations took place. In this work an influence of these oscillations on ion beam transversal dispersedness is studied. Measurements demonstrate increasing of beam dispersedness when discharge oscillations amplitude is increased. (auth)

11696 (LBL—3399(Suppl.), pp II.10.1-II.10.4) **Formation of intense ion beam with a multiple-slot extractor.** Kulygin, V.M. (I. V. Kurchatov Inst. of Atomic Energy, Moscow); Panassenkov, A.A.; Semashko, N.N.; Boldasov, V.S.; Volkov, B.I.; Sveshnikov, A.G. 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

Computer calculations for the design of a slotted extractor for a source of intense beams of hydrogen ions are described. The ion trajectories from the source are determined by the program. The resulting extractor design was tested, and results of the tests are presented. (GHT)

11697 **Secondary electron emission induced by 5-30-keV monatomic ions strking thin oxide films.** Dietz, L.A.; Sheffield, J.C. (General Electric Co., Schenectady, NY). *J. Appl. Phys.*; **46**: No. 10, 4361-4370(Oct 1975).

An experimental investigation was made of how ion velocity and angle of incidence affect the magnitude and uniformity of secondary electron yield from thin amorphous oxide films. Flat target surfaces of Al_2O_3 and BeO in a high vacuum of 10^{-8}—10^{-9} torr were bombarded with singly-charged positive ions of Li, Na, K, Rb, Cs, and Ni isotopes. Each of these elements has a different yield versus velocity response. The data are consistent with Parilis and Kishinevskii's prediction of a common velocity threshold. The estimate of the threshold velocity is 5.5 x 10^8 cm/sec. For a given element within experimental error, isotopes of different masses but with the same impact velocity produce identical average secondary electron yields. Furthermore, the statistical variances of their secondary electron frequency distributions also are identical. These results demonstrate the absence of an isotope effect on secondary electron emission. In general, secondary electron yield is not linear with ion velocity. Additional results were obtained for MgO and Ta_2O_5 surfaces. It was found that secondary electron yield depends strongly on the electronic shell structure of a projectile ion, that is, on its atomic number Z. The data can be interpreted qualitatively using the Fano—Lichten—Barat electron promotion model for ion-atom collisions when the Z's are unequal. A statistical model of secondary electron emission is described in which each ion-atom collision below a surface may result in the release of one or more electrons. In this model the random sequence or order in which target atoms are struck, the unequal amount of electronic excitation generated during collisions of a projectile ion with different kinds of target atoms, and the electronic properties of an oxide surface are all factors which shape the frequency distribution of observed secondary electrons. (auth)

11698 **Observation of anode ions associated with pinching in a relativistic electron beam diode.** Swain, D.W.; Goldstein, S.A.; Kelly, J.G.; Hadley, G.R. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.*; **46**: No. 10, 4604-4605(Oct 1975).

Ions originating at the anode of a relativistic electron beam (REB) accelerator are observed at the cathode by a means of a Faraday cup. The dominant species is H^+, probably from adsorbed impurities. These ions, having energies equal to the diode voltage, are not observed until 20 to 40 J/cm² are deposited by the beam on the anode surface, and are closely associated with the formation of a pinch at the anode. (auth)

11699 Measurements of x-ray atomic scattering factors of high-Z metals. Tirsell, K.G.; Slivinsky, V.W.; Ebert, P.J. (Univ. of California, Livermore). *Phys. Rev., A;* **12**: No. 6, 2426-2437(Dec 1975).

The coherent scattering of 25- to 75-keV filtered fluorescence Kα radiation from thin Sn, Sm, Ta, Pt, and Au foils has been measured absolutely. Values of atomic scattering factors in the range of q = sin(theta/2)/lambda from 0.5 to 5.5 A^{-1} were obtained for five different incident energies with scattering angles ranging from 45 to 135°. The results are compared with Cromer's recent relativistic Dirac-Slater calculations with and without anomalous dispersion corrections. When plotted against the ratio of the target K-edge energy to the incident energy, differences between measured and calculated scattering factors follow the same general trend for all these high-Z elements. Before they are corrected for dispersion, the calculated scattering factors for incident energies below the target K-absorption edge exceed the measured values, with the difference increasing in magnitude as the K edge is approached. After the dispersion correction, the calculated values are all lower than the measured values by about 1.3 units. For incident energies above target K edges, differences are generally small; but uncorrected calculated scattering factors also exceed the experimental values in a rapidly increasing manner as the K edge is approached. After they are corrected for dispersion, calculated values are lower than measured values by about 0.6 units. Improved agreement can be obtained over the whole energy range for each element by arbitrarily reducing the magnitude of the real part of the dispersion correction term to that of the principal anomalous term. (auth)

11700 Production of intense proton fluxes in a magnetically insulated diode. Dreike, P.; Eichenberger, C.; Humphries, S.; Sudan, R. (Laboratory of Plasma Studies, Cornell University, Upson Hall, Ithaca, New York 14850). *J. Appl. Phys.;* **47**: No. 1, 85-87(Jan 1976).

A magnetically insulated diode has been used to produce intense fluxes of protons with high efficiency. Currents in excess of 4 kA with current density greater than 50 A/cm² have been produced in a 50-nsec bursts at energies up to 200 keV. The system appears to be easily scalable to higher parameters. The extraction of the beams, as well as geometries in which current densities of kA/cm² may be realized, are discussed. (AIP)

11701 Determination of energy spectra of backscattered electrons by use of Everhart's theory. McAfee, W.S. (US Army Electronics Command, Fort Monmouth, New Jersey 07703). *J. Appl. Phys.;* **47**: No. 3, 1179-1184(Mar 1976).

Everhart's theory on the backscatter of electrons from solids is extended so as to yield the backscatter coefficient as a function of the retarding potential rejecting backscattered electrons having energies below a certain fraction of the energy of the primaries. From this function an analytical expression is obtained for the energy spectra of backscattered electrons with the atomic number of the target material as a parameter. Limited comparisons with experiments are included. The theory is found to give reasonable agreement with electron backscatter experiments for primary electron energies above about 1 keV and target materials having atomic numbers up to about 40. The upper energy limit of perhaps 100 keV is set by the relative importance of bremsstrahlung and relativistic effects which are not included in the Thomson-Whiddington law. Theoretical energy spectra display observed behavior of measured spectra under variation of the atomic number of the target. Energy spectra obtained from this theory give results which are in rather good agreement with experiment for backscattered electrons having energies in the range of about 0.25 to 0.90 of the energy of primary electrons. (AIP)

ATOMIC AND MOLECULAR PROPERTIES

REFER ALSO TO CITATION(S) 11269, 11741, 12098

11702 (TID—26944) **Satellite structure in the photoelectron spectra of rare gases, some simple gaseous molecules, and alkali metal halides.** Spears, D.P. (Oak Ridge National Lab., Tenn. (USA)). 1973. 103p. Dep. NTIS $5.50.

Thesis.

The rare gases Ar, Kr, and Xe, the alkali metal ions, and several simple molecules were studied to get insight into the excitation mechanism involved in the transitions to excited states. The satellite lines in the photoelectron spectra of both the inner and outer shells were studied. The satellite lines in the photoelectron spectra of the outer shells of the rare gases are compared with optical data. In the case of Ar and Kr, configuration interaction was found to be more important than electron shakeup. The photoelectron spectra of the valence shells of the alkali halides NaCl, KCl, KBr, RbCl and CsCl were run and the satellite structures compared with those of the rare gases. The satellite lines in the spectra of NO, N_2O, H_2O and N_2 are discussed. 9 tables, 24 figures, 66 references. (GHT)

11703 (UCRL-Trans—10746) **Spectroscopy using a laser source. III. Intensities and line widths for the $00^01\text{-}10^00$ transition of nitrous oxide. Deviations from the Lorentzian line shape.** Lacome, N.; Boulet, C.; Arie, E. Translated by M.R. Martin from *Can. J. Phys.;* **51**: No. 3, 302-310(1 Feb 1973). 12p. Dep. NTIS $3.50.

Intensities and half-widths of self-broadened N_2O have been measured in the $00^01\text{-}10^00$ band by a spectroscopic method using a stabilized, single line, single mode laser source. On the other hand, line overlap has permitted us to point out a deviation from Lorentz line shape for pressures greater than atmospheric pressure. An attempt to interpret this difference by a semi-empirical formalism is proposed, proceeding from "super Lorentz" line shape recently introduced by Varanasi.

11704 Optimal even-tempered Gaussian atomic orbital bases: first-row atoms. Raffenetti, R.C. (National Aeronautics and Space Administration, Hampton, VA). *Int. J. Quant. Chem., Symp.;* No. 9, 289-295(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Atomic Hartree—Fock self-consistent-field energy-optimized even-tempered Gaussian bases are obtained for hydrogen, helium and all first-row atoms in their ground states. In comparison with Huzinaga-type bases the present energies are found to form somewhat weaker upper bounds. The utilization of the even-tempered Gaussian atomic orbital bases in molecular calculations is discussed with regard to their special capabilities. (auth)

11705 Hartree—Fock Compton profiles for the elements. Biggs, F. (Sandia Labs., Albuquerque, NM); Mendelsohn, L.B.; Mann, J.B. *At. Data Nucl. Data Tables;* **16**: No. 3, 201-309(Sep 1975).

Orbital and total-atom Compton profiles are given for the elements. Hartree-Fock wavefunctions were used in the numerical calculations for atomic numbers 1 less than or equal to Z less than or equal to 36 and relativistic Dirac—Hartree—Fock wavefunctions for atomic numbers 36 less than or equal to Z less than or equal to 102.

11706 Soft-x-ray amplified spontaneous emission via the Auger effect. McGuire, E.J. (Sandia Labs., Albuquerque, NM). *Phys. Rev. Lett.;* **35**: No. 13, 844-848(29 Sep 1975).

It is proposed that amplified spontaneous emission in the soft-x-ray region can be obtained using inner-shell population inversions arising from the Auger effect. For Na^+, it is shown that with present-day technology it appears possible to generate a pulse of 10^{-5} to 10^{-7} J in less than a nanosecond at 410 A. The possible effect of interatomic Auger processes in the solid is discussed but high-electron-density effects are not accounted for. (auth)

11707 Rotational motion under pressure in the solid molecular hydrogen isotopes. England, W. (Argonne National Lab., IL); Raich, J.C.; Etters, R.D. *J. Low Temp. Phys.;* **22**: No. 1/2, 213-222(Jan 1976).

Rotational states as functions of pressure for H_2, D_2, T_2, HD, and HT molecules are calculated in the corresponding molecular solids. Sudden transitions from spherically symmetric rotational states occur in para-H_2, para-T_2, ortho-D_2, and in HD and HT as the pressure increases. Only the predicted T_2 transition pressure of about 24 kbar lies within current experimentally accessible ranges. All other transitions occur in the region 150-300 kbar. (auth)

11708 Temperature dependence of hyperfine density shifts. IV. ^{23}Na, ^{39}K, and ^{85}Rb in He, Ne, Ar, and N_2 at low temperatures. Bean, B.L.; Lambert, R.H. (University of New Hampshire, Durham, New Hampshire 03824). *Phys. Rev., A;* **13**: No. 1, 492-494(Jan 1976).

Measurements of the temperature dependence of the hyperfine density shifts of ^{23}Na, ^{39}K, and ^{85}Rb in He, Ne, Ar, and N_2 buffer gases have been extended to low temperatures (-125 to 25 degree C). The results confirm and extend the nonlinear temperature dependence. Low-order polynomial fits of the density shifts vs T (degreeC) have been calculated for each alkali metal and buffer gas. (AIP)

11709 Spline bases for atomic calculations. Altenberger-Siczek, A.; Gilbert, T.L. (Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.*; **64**: No. 1, 432-433(1 Jan 1976).

The use of spline bases has been proposed for ab initio electronic structure calculations. They offer the apparent advantage that no nonlinear parmameters occur, so that exponent optimization is unnecessary, and the number of two-electron integrals in SCF calculations increases only as n^2 rather than n^4 where n is the number of basis functions. The results of test calculations on the helium atom are reported in this note. Analysis of the computer time required to achieve accuracy comparable to other methods indicates that spline bases are not suitable for SCF calculations. (AIP)

11710 Energy levels of the first spectrum of curium, Cm I. Worden, E.F.; Conway, J.G. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *J. Opt. Soc. Am.*; **66**: No. 2, 109-121(Feb 1976).

The curium spectrum emitted by electrodeless lamps was observed from 2400 to 11,500 A and the wavelengths of over 13,250 lines were accurately measured. Zeeman effect and spectrum-assignment plates were photographed from 2400 to 9000 A. From data obtained on the spectrum-assignment plates, over 6800 lines were assigned to Cm I and over 4050 lines were assigned to the Cm II spectrum. The analysis of the Cm I spectrum has produced 335 odd levels and 348 even levels that combine to classify over 5025 Cm lines. Only the energy levels are presented here. The Lande g values of most levels have been obtained from the Zeeman effect data and isotope shifts were determined for many levels. These data were useful in the assignment of levels to electronic configurations of Cm I. The ground configuration of Cm I is $Rn5f^7\ 6d\ 7s^2$ and the lowest level of the $Rn5f^8\ 7s^2$ configuration is only 1214 cm^{-1} above the ground level. (AIP)

POSITRONIUM, MUONIUM, AND MUONIC AND MESIC ATOMS AND MOLECULES

REFER ALSO TO CITATION(S) 11802

11711 (COO—3533-64(Vol.2); pp VI.17-VI.23) **Stopping negative particles in chemical compounds.** Derrick, M. (Argonne National Lab., IL). 1975.

From 4. international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In Proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume 2. Chapters 5—8.

An experiment in which antiprotons were stopped in C_3H_8 is described. The resulting pictures were scanned for the reactions: anti-pp yields $\pi^+\pi^-$, and anti-pp yields K^+K^-, to determine what fraction of the antiprotons annihilate on free protons and are not predominately transferred to the carbon as seems to happen for π^- mesons. (GHT)

11712 Kaonic and other exotic atoms. Seki, R. (California State Univ., Northridge); Wigand, C.E. *Annu. Rev. Nucl. Sci.*; **25**: 241-281(1975).

Topics covered in this review include: basic characteristics of exotic atoms; experimental findings of x-ray intensities of kaonic, sigmonic, and antiprotonic atoms; level shifts and widths; particle properties derived from exotic atoms, including mass, magnetic moment, and polarizability; atomic phenomena directly related to nuclear properties, such as nuclear quadrupole moment and dynamical quadrupole mixing; products from nuclear absorption of K^-, Σ^-, and anti p. Theoretical information presented includes: atomic capture and cascade; K^--nucleus optical potential; anti p- and Σ^--nucleus optical potential; and two- and one-nucleon absorption products. 9 figures, 6 tables, 134 references. (GHT)

11713 Chemical effects in negative muon capture in some ionic and covalent solids and ionic aqueous solutions. Knight, J.D.; Orth, C.J.; Schillaci, M.E.; Naumann, R.A.; Daniel, H.; Springer, K.; Knowles, H.B. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., A*; **13**: No. 1, 43-53(Jan 1976).

Muonic x-ray spectra have been measured for target sequences including graphite, diamond, their boron-nitride counterparts, three organic compounds, ice and water, eight oxides of metals, alkali halides in aqueous solution and alkali chlorides in anhydrous crystalline form, and calcium and titanium hydrides. Comparisons are made of Lyman-series intensity patterns, and relative muon capture probabilities in the constituent elements of compounds are compared with "Z-law" relation. The Lyman intensities of the C and N in the low-Z targets are found to exhibit two kinds of pattern, one with relatively weak higher-series members characterizing the diamond and graphite structures, and one with stronger higher-series members characterizing the other (hydrogen-containing) compounds. There is some evidence that the latter intensity behavior applies to the aqueous ions as well. For the oxide sequence, increasing covalency appears to correlate with increasing muon capturing ability of the metal element and with increasing intensity of the higher Lyman members for both the metal element and the oxygen. Effective relative muon-capture cross sections have been obtained for aqueous alkali and halide ions. (AIP)

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 11682, 11705, 11927, 12066

11714 (COO—7B-15) **Technical progress report, October 1, 1974—September 30, 1975.** (Wisconsin Univ., Madison (USA). Dept. of Physics). 1975. Contract E(11-1)-Gen-7. 48p. Dep. NTIS $4.00.

Topics covered include: equilibrium fractions when D^+, D_2^+, or D_3^+ ions are incident on a Cs vapor target; charge exchange collisions when hydrogen and deuterium ions are incident on a Cs vapor target; charge exchange cross sections with rare gas ions incident on a Cs vapor target; the production of He^- ions in a Cs target; and direct production of polarized H^- or D^- ions. 10 figs. (GHT)

11715 (COO—3570-17) **Research on high-energy chemical reactions. Annual progress report, August 1, 1974—October 31, 1975.** Cross, R.J. Jr. (Yale Univ., New Haven, Conn. (USA). Dept. of Chemistry). Oct 1975. Contract E(11-1)-3570. 10p. Dep. NTIS $3.50.

Product yields for the reactions $T^* + c\text{-}C_6D_{12}$ yields $c\text{-}C_6D_{11}T$, DT have been measured using a beam of T^* formed by charge exchange in the energy range of 25 eV to 100 eV. A computer program was written to calculate the probability of collision vs. energy of a beam of T^* moderated by He gas. (auth)

11716 (LBL—3399(Suppl.), pp II.11.1-II.11.3) **Investigation of a gas cell plasma, generated by charge exchange of intense ion beam.** Kulygin, V.M.; Panassenkov, A.A. (I. V. Kurchatov Inst. of Atomic Energy, Moscow). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

The parameters of a secondary plasma, generated in a gas cell by charge exchange of a hydrogen ion beam, extracted from a plasma source, are investigated. Measurements show that secondary plasma parameters change considerably along the gas cell. Near the source, the plasma density is about $5 \cdot 10^{10}$ cm^{-3}, electron temperature is about 1 eV, and plasma potential is about 4 V. Toward the end of the cell plasma density decreases considerably, electron temperature increases to 7 + 8 eV, and plasma potential increases to 60 V. (auth)

11717 (LBL—3529) **Molecular beam kinetics.** Behrens, R. Jr. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 299p. Dep. NTIS $9.25.

Thesis.

The design of a crossed molecular beam "supermachine" for neutral—neutral collisions is discussed. The universal electron bombardment ionizer, mass filter, and ion detection system of the detector, the supersonic nozzle sources, the differential pumping arrangement for the sources and detector, the time-of-flight detection of scattered products, and the overall configuration of the apparatus are described. The elastic scattering of two systems, CH_4 + Ar and NH_3 + Ar, has been measured using the supermachine with two supersonic nozzle sources. The rainbow structure and the interference oscillations are seen in each system. The best fit to the data was found using a Morse—Spline—Van der Waals (MSV) potential. The three potential parameters epsilon, r/sub m/, and β were found to be 2.20(+-0.04) x 10^{-14} ergs, 3.82(+-0.04)A, and 7.05 +- 0.20 for CH_4 + Ar, and 2.21(+-0.04) x 10^{-14} ergs 3.93 (+-0.05)A, and 8.45 +- 0.30 for NH_3 + Ar. A new phenomenon in crossed molecular beams of condensation of a molecule on a cluster to form a complex was observed. A bromine molecule condensed on clusters of chlorine (Cl_2)/sub chi/ and ammonia (NH_3)/sub chi/. The value of chi for measurements in these experiments ranges from 7 to 40 for chlorine clusters and from 10 to 70 ammonia clusters. (auth)

11718 (SAN—936X10) **Energy distributions of secondary electrons from Ar, N_2, H_2O, and H_2O with clusters present.** Mathis, R.F.; Vroom, D.A. (IRT Corp., San Diego, Calif. (USA)). 1976. 15p. Dep. NTIS $3.50.

Crossed beam measurements have been made of the energy spectra of secondary electrons resulting from collisions of 1 keV primary electrons with N_2, Ar, H_2O, and H_2O with clusters present. Only those electrons emitted normal to the primary beams were detected. A thorough description of the apparatus is given. (auth)

11719 (TID—26983) **Inelastic molecular collisions: application of theoretical methods to problems relevant to laser operation. Progress report, February 1, 1975—November 1, 1975.** (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). 1975. Contract AT(11-1)-2555. 14p. Dep. NTIS $4.50.

Information is presented on the decomposition theory of molecular collisions for non-reactive and reactive scattering. The basic theoretical problem of calculating molecular collision phenomena is discussed. Research done in these areas from Feb. 1, 1975 to Nov. 1, 1975, is described. (GHT)

11720 (UCID—15644-75-2, pp 16) **Chemical modeling and theoretical chemistry. Cross sections for the elastic and inelastic scattering of electrons by molecules.** Bender, C.F.; Rescigno, T.N.; McCurdy, C.W.; McKoy, V. 3 Sep 1975.

In General Chemistry Division quarterly report, April—June 1975.

11721 **Branching ratios in reactive collisions: theory versus experiment.** Bernstein, R.B. (Univ. of Texas, Austin). *Int. J. Quant. Chem., Symp.;* No. 9, 385-395(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Recent experimental and theoretical studies of branching ratios in elementary bimolecular reactions are reviewed. Examples include both direct- and complex-mode reactions of neutral reagents yielding alternative sets of products (neutral or ionic as the case may be). The information-theoretic approach to branching ratios (and intramolecular isotope effects) for direct, exoergic reasons is illustrated. Recent molecular beam experiments on the energy dependence of the branching ratio for the decay of alkali halide—alkali collision complexes are discussed. (auth)

11722 **Electronic states of ions recoiling into vacuum and gases.** Datz, S. (Oak Ridge National Lab., TN). *Phys. Scr.;* **11**: 149-156(1975).

In the study of hyperfine interactions of nuclear states created by nuclear reaction or Coulomb excitation the recoiling ion undergoes a series of collisions in which electrons are captured and lost and in which electronic excitation and deexcitation take place. A knowledge of the electronic states of the ion on a time scale comensurate with the lifetime of the nuclear states (1 to 100 ps) is vital to the understanding of the field at the nucleus. Atomic collision processes in dilute and dense media are discussed in terms of charge changing and excitation of both inner and outer shell electrons and the application to some perturbed angular correlation measurements are given.

11723 **Vacuum-ultraviolet emission from high-pressure krypton.** Koehler, H.A.; Ferderber, L.J.; Redhead, D.L.; Ebert, P.J. (Univ. of California, Livermore). *Phys. Rev., A;* **12**: No. 3, 968-973(Sep 1975).

Krypton gas was excited by high-current relativistic electron bursts, and spectral and temporal characteristics of the uv continuum peaked at 1460 A were measured as functions of pressure. Gas pressure ranged from 0.14 to 68 atm. The spectral full width at half-maximum of 90 +- 6 A was virtually independent of pressure from 3.4 to 68 atm. Exponential time constants for the buildup and decay of the uv intensity obeyed at $P^{-1.5}$ pressure dependence for P less than 4 atm. Three pressure-independent intensity decay constants of 9 +- 1.5, 32 +- 6, and 350 +- 70 nsec were obtained for P greater than 6 atm. The efficiency for conversion of electron kinetic energy to uv energy was (4 +- 1.6) percent. (auth)

11724 **Tables of transport collision integrals for (n,6,4) ion-neutral potentials.** Viehland, L.A. (Brown Univ., Providence, RI); Mason, E.A.; Morrison, W.F.; Flannery, M.R. *At. Data Nucl. Data Tables;* **16**: No. 6, 495-514(Dec 1975).

Transport collision integrals are tabulated for the (n,6,4) model of ion-neutral-molecule interactions as functions of effective ion temperature for eight values of n and several values of a parameter γ that measures the relative strengths of the r^{-6} and r^{-4} attraction terms. The ions can have any charge and the neutral entities can be either atoms or spherically symmetric molecules. The accuracy of the calculations is estimated to be a few parts in 10^4. The tables can be used to estimate ion-neutral potentials by comparison with experimental ion mobility data or conversely can be used to estimate ion mobilities and diffusion coefficients as functions of gas temperature and electric field strength from fragmentary information. (auth)

11725 **X rays from foil-excited iodine beams.** Cocke, C.L. (Kansas State Univ., Manhattan); Varghese, S.L.; Bednar, J.A.; Bhalla, C.P.; Curnutte, B.; Kauffman, R.; Randall, R.; Richard, P.; Woods, C.; Scofield, J.H. *Phys. Rev., A;* **12**: No. 6, 2413-2419(Dec 1975).

M—x-ray spectra from foil-excited iodine beams between 40 and 62 MeV have been studied using a bent-crystal spectrometer. The prompt spectrum is so rich as to defy analysis, but the delayed spectrum exhibits a number of resolved lines. Electric quadrupole 4s yields 3d transitions are observed from metastable systems in the NiI, CuI, and ZnI isoelectronic sequences. Electric dipole 4p yields 3d transitions from states in these isoelectronic sequences also appear downstream. Transition energies and quadrupole lifetimes have been measured and are compared with the results of both relativistic and nonrelativistic calculations. (auth)

11726 **Focused intense ion beams using self-pinched relativistic electron beams.** Poukey, J.W.; Freeman, J.R.; Clauser, M.J.; Yonas, G. (Sandia Laboratories, Albuquerque, New Mexico 87115). *Phys. Rev. Lett.;* **35**: No. 26, 1806-1808(29 Dec 1975).

A new two-dimensional diode simulation code is used to show the possibility of using hemispherical diodes to produce converging ion beams in the 1—10-MA range. The pinched electron flow enhances ion emission, while suppressing electron emission, allowing I/subi//I/sube/>1. Such focused ion beams are of considerable interest for use in ablatively driven implosions of fusion targets. (AIP)

11727 **Electron-impact excitation of atomic oxygen.** Smith, E.R. (Air Force Cambridge Research Laboratories, Hanscom AFB, Massachusetts 01731). *Phys. Rev., A;* **13**: No. 1, 65-73(Jan 1976).

The excitation cross sections Q (^{3}P-3s ^{5}S/subo/) and Q (^{3}P-3s ^{5}S/subo/) are calculated using a close-coupling formalism, which includes exchange effects. A cascade-adjusted cross section for Q (^{3}P-3s ^{5}S/subo/) is obtained which agrees with the experimental cross section of Stone and Zipf within estimated error uncertainties. Finally, some discussion is given concerning the effects of poorly positioned O^- autodetaching states, which are introduced by an inadequate close-coupling expansion. (AIP)

11728 **Ionization, charge exchange, and excitation in F + Ar and F + Kr collisions.** Hopkins, F.; Brenn, R.; Whittemore, A.R.; Cue, N.; Dutkiewicz, V.; Chaturvedi, R.P. (Department of Physics, State University of New York, Stony Brook, New York 11794). *Phys. Rev., A;* **13**: No. 1, 74-85(Jan 1976).

We have measured projectile and target x-ray cross sections for F + Ar and F + Kr collisions using fluorine beams of charge states 7+, 8+, and 9+ with energies from 20 to 76 MeV. Pronounced enhancements for the Ar K and Kr L vacancy cross sections using F^{9+} ions compared to those for the 7+ projectile can be explained by charge exchange as described by an empirically scaled Brinkman-Kramers theory. The Ar L, Kr K, and Kr M cross sections are found to exhibit features expected for Coulomb ionization. The projectile K x-ray production for the 9+ ion is accounted for by charge exchange processes. Predictions of the first Born approximation for direct single-step excitation to bound states by the target nucleus overestimate the observed cross sections for F^{7+} and F^{8+}. (AIP)

11729 **Diabatic-states representation for He* (n > or = 3) + He collisions.** Cohen, J.S. (Theoretical Division (T-6), Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). *Phys. Rev., A;* **13**: No. 1, 86-98(Jan 1976).

A diabatic-states representation for scattering of triplet helium atoms, with n*/> or = 3, by the ground-state helium atom is presented. Ab initio calculations have been performed on the $^3\Sigma^+$/subg/,subu/, ^{3}Pi/subg/,/subu/, and $^3\Delta$/subg/ Rydberg states of He_2. Matrix elements for radial and angular coupling between the orthogonalized diabatic states have also been evaluated. The angular couplings are quite weak, with the result that molecular states with different electronic symmetries are effectively uncoupled in low-energy collisions. The crossing by a repulsive diabatic-potential curve through the Rydberg series and into the continuum is shown to be an effective mechanism for associative ionization. Some qualitative observations on associative ionization and dissociative recombination are made. (AIP)

11730 **Multistate curve-crossing model for scattering: Associative ionization and excitation transfer in helium.** Cohen, J.S. (Theoretical Division (T-6), Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). *Phys. Rev., A;* **13**: No. 1, 99-114(Jan 1976).

A model has been derived to treat the multistate curve-crossing problem which often arises in diabatic representations of scattering processes. Transitions between diabatic states are assumed to occur only in the vicinity of curve crossings and the probabilities are evaluated semiclassically. Otherwise the nuclear trajectories are treated classically except for tunneling through long-range potential barriers taken into account by the JWKB approximation. Closed channels are included on an equal footing with the scattering channels. The model is applied to the problems of symmetric associative (and dissociative) ionization and excita-

tion transfer in collisions of excited helium with the ground-state atom, using the diabatic representation for the Rydberg states of He_2 presented in the preceding paper. The electronic coupling of the repulsive diabatic states in the continuum yields much larger ionization cross sections than does direct vibronic coupling of low-lying adiabatic states to the continuum. The diabatic-states model is shown to be a valid interpretation of associative ionization in helium. Ionization has a significant effect on some excitation-transfer cross sections. Integrated cross sections are presented for ionization of helium in the n ^{3}S, n ^{3}P, and n ^{3}D states, n = 3,4, and for excitation transfer from the n = 3 states to states with 2 < or = n < or = 4 for collision energies from thermal to 100 eV. The thermally averaged associative ionization cross sections, in units of 10^{-16} cm^3, obtained at 300 degreeK are as follows: Q/subi/(3 ^{3}S) = 0.06, Q/subi/(3 ^{3}P) = 2.0, Q/subi/(3 ^{3}D) = 2.9, Q/subi/(4 ^{3}S) = 0.6, Q/subi/(4 ^{3}P) = 1.7, and Q/subi/(4 ^{3}D) = 4.3. The results are in quite satisfactory agreement with recent experiments. (AIP)

11731 Angular scattering of low-energy electrons by atomic oxygen. Dehmel, R.C.; Fineman, M.A.; Miller, D.R. (Department of Applied Mechanics and Engineering Sciences, University of California, San Diego, La Jolla, California 92093). *Phys. Rev., A;* 13: No. 1, 115-122(Jan 1976).

The differential cross sections for electrons scattered by He, O, Ar, and O_2 at 15 eV and by O and O_2 at 5 eV have been determined using a modulated crossed-beam technique. The results for He, Ar and O_2 agree well with previously published experimental and theoretical values. Measurements on O_2 extend to larger backscattered angles than previously reported. Results for O are compared with the theoretical calculations of Thomas and Nesbet. Reasonable agreement with theory is obtained at 5 eV, and while the calculations only extend to 11.0 eV, the trend in shape appears correct at 15 eV. A small-angle dip in the cross section is observed which is not predicted by the theory. (AIP)

11732 Electron scattering from atoms in the presence of a laser field. Gersten, J.I.; Mittleman, M.H. (Physics Department, The City College of the City University of New York, New York, New York 10031). *Phys. Rev., A;* 13: No. 1, 123-130(Jan 1976).

The formal development of the problem of electron-atom scattering in the presence of a laser field is considered. A time-dependent close-coupling method and a time-dependent optical-potential method are presented. With hydrogen as an example, and a weak laser tuned near the 1S-2P resonance, the effective long-range potentials are explicitly obtained. These potentials are time dependent, noncentral, and fall off as r$^-$/subn/, where we limit ourselves to terms with n = 2, 3, and 4. They are then used to find the elastic, inelastic, and superelastic cross sections for small momentum transfer. (AIP)

11733 Radiative transitions in atom-atom scattering in intense laser fields. Lau, A.M.F. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., A;* 13: No. 1, 139-147(Jan 1976).

The quantum nonperturbative analysis of Kroll and Watson for a two-level system of near-adiabatic atom-atom scattering in an intense laser-field mode is extended to treat a general multilevel system interacting with intense single- or many-field modes. A procedure for rigorously solving the adiabatic eigenvalue problem for the whole charge-field system is given. A new transition-probability formula is derived. Cross sections are calculated for the processes Li + H(X $^1\Sigma^+$) + $\nu\hbar\omega$ yields Li + H(A $^1\Sigma^+$ or B ^{1}Pi) where $\nu >$ or = 1. Analysis of transition in an atom due to intensity variation of a laser pulse shows that desired transition probability per pulse (e.g., 1/2) may be achieved by varying the pulse parameters. For this, numerical results of Na(3s) + 2$\hbar\omega$ yields Na(5s) and of Li(2s) + 8$\hbar\omega$ yields Li(3s) are given. (AIP)

11734 Excitation of the Mg and Mg^+ resonance lines by electron impact on Mg atoms. Leep, D.; Gallagher, A. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, Colorado 80302). *Phys. Rev., A;* 13: No. 1, 148-155(Jan 1976).

We have measured the optical excitation functions and polarizations of the Mg resonance line (2852 A) and of the Mg^+ resonance lines (2796 A, 2803 A, unresolved) arising from ionizing excitation of magnesium atoms, for electron-impact energies from the excitation thresholds to 1400 eV. In our crossed-beam apparatus, the electron-beam energy resolution was ≅0.25 eV for energies below 10 eV, and the atom beam was optically thin. The excitation function of the ionic lines was normalized to that of the atomic line by relative intensity measurements. The 2852-A excitation function, when normalized to Born theory in the high-energy limit, has a maximum cross section of 17.3 πa_0^2+-3% at 18.5 eV. This excitation function is graphically compared with the resonance-line excitation functions of Na, Ca, and Li previously measured in this laboratory. The 2852-A polarization function is consistent with the theoretical threshold limit of +100%, and has a sharp feature near 5 eV which cannot be due to cascading. (AIP)

11735 Electron impact excitation of the 3S, 3P, and 3D states of H. Mahan, A.H.; Gallagher, A.; Smith, S.J. (Joint Institute for Laboratory Astrophysics, National Bureau of Standards and University of Colorado, Boulder, Colorado 80302). *Phys. Rev., A;* 13: No. 1, 156-166(Jan 1976).

The relative excitation function for electron impact excitation of H to yield Balmer α has been measured from threshold to 500-eV collision energy in a crossed-beam apparatus. The relative contributions of the 3S, 3P, and 3D states to this excitation function have been measured by modulating the electron beam and discriminating on the basis of their different lifetimes for radiative decay after excitation. The resulting set of relative 3S, 3P, and 3D cross sections has been normalized by equating the total measured Balmer-α cross section at 500 eV to the Born approximation. The normalized cross sections are then compared to available theories at lower energies. In contrast to virtually all known excitation cross sections of neutral atoms, which fall below the Born theory at low energies, the H (1S yields 3D) cross section exceeds the Born theory, apparently owing to coupling between of the 3D and 2P states. (AIP)

11736 Microwave transient-response measurements of elastic momentum-transfer collision frequencies in argon. McPherson, D.A.; Feeney, R.K.; Hooper, J.W. (Georgia Institute of Technology, School of Electrical Engineering, Atlanta, Georgia 30332). *Phys. Rev., A;* 13: No. 1, 167-179(Jan 1976).

A microwave transient-response technique has been used to determine electron-neutral elastic momentum-transfer collision frequencies in argon as a function of electron energy in the range from 0.08 to 4 eV. An analytical technique has been developed for the unfolding of the monoenergetic collision-frequency data from the measured transient-response decay rate. The over-all experimental and analytical error is estimated to be less than +- 25% except in the immediate vicinity of the argon Ramsauer minimum where the transient-response results may considerably overestimate the true collision frequency. The results are compared with argon collision-frequency data derived from previous dc swarm measurements and modified effective-range conversions of total elastic scattering data. The transient-response results agree well with the dc swarm data except at the Ramsauer minimum, where the transient-response data agree more closely with the modified effective-range results. (AIP)

11737 Hybrid theory and calculation of e-N_2 scattering. Chandra, N.; Temkin, A. (Theoretical Studies Group, Goddard Space Flight Center, National Aeronautics and Space Administration, Greenbelt, Maryland 20771). *Phys. Rev., A;* 13: No. 1, 188-203(Jan 1976).

A theory of electron-molecule scattering is developed which is a synthesis of close-coupling and adiabatic-nuclei theories. Specifically, the theory is close coupling with respect to vibrational degrees of freedom but adiabatic-nuclei with respect to rotation. In addition, this theory can be applied to any number of partial waves required; the remaining ones can be calculated purely in one or the other approximation. A theoretical criterion based on fixed-nuclei calculations and not on experiment can be given as to which partial waves and energy domains require the various approximations. The theory allows all cross sections (i.e., pure rotational, vibrational, simultaneous vibration-rotation, differential, and total) to be calculated. Explicit formulas for all these cross sections are given. The theory is applied to low-energy e-N_2 scattering. The fixed-nuclei results are such that the criterion shows clearly that vibrational close coupling is necessary, but only for the Pi/subg/ partial wave. The contribution of remaining partial waves can be obtained directly from the adiabatic-nuclei approximation. The close-coupling calculation for the Pi/subg/ wave is carried out, and we find that it does give rise to the substructure as well as the gross structure of the 2.4-eV resonance. When this amplitude is combined with the adiabatic amplitudes, we can compute absolute values ofll cross sections of interest. In particular we find that vibrational excitation cross sections are about twice as large as previously inferred. The momentum-transfer cross section can also be computed, and it too reveals substructure within the gross structure resonance. (AIP)

11738 Experimental impact-parameter—dependent probabilities for K-shell vacancy production by fast heavy-ion projectiles. Randall, R.R.; Bednar, J.A.; Curnutte, B.; Cocke, C.L. (Kansas State University, Manhattan, Kansas 66506). *Phys. Rev., A;* 13: No. 1, 204-215(Jan 1976).

The impact-parameter dependence of the probability for production of target K x rays has been measured for oxygen projectiles on copper and for carbon and fluorine projectiles on argon at scaled velocities near 0.5. The O-on-Cu data were taken for

1.56-, 1.88-, and 2.69-MeV/amu O beams incident upon thin Cu foils. A thin Ar-gas target was used for 1.56-MeV/amu C and F beams, permitting measurements to be made for charge-pure C^{+4}, C^{+6}, F^{+6} and F^{+8} projectiles. Ar and Cu K x rays were observed with a Si(Li) detector and scattered projectiles with a collimated surface-barrier detector. Comparison of the shapes of the measured K-vacancy—production probability curves with predictions of the semiclassical Coulomb approximation (SCA) shows adequate agreement for the O-on-Cu system. For the higher ratio of projectile-to-target nuclear charge (Z_1/Z_2) characterizing the C-on-Ar and F-on-Ar systems, the SCA predictions are entirely inadequate in describing the observed impact-parameter dependence. In particular, they cannot account for large probabilities found at large impact parameters. Furthermore, the dependence of the shapes on the projectile charge state is found to become pronounced at larger Z_1/Z_2. Attempts to account for this behavior in terms of alternative vacancy-production processes are discussed. (AIP)

11739 Low-energy electron-impact excitation of the hydrogen molecule. Rescigno, T.N.; McCurdy, C.W. Jr.; McKoy, V.; Bender, C.F. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). *Phys. Rev., A;* 13: No. 1, 216-223(Jan 1976).

We present cross sections for the excitation of the two lowest (b $^3\Sigma^+$/subu/ and a $^3\Sigma^+$/subg/) triplet states of molecular hydrogen by electron impact for incident electron energies < or = 20 eV. The cross sections are calculated using the distorted-wave approximation with the inelastic transition density obtained in the random-phase approximation. An efficient expansion technique using Gaussian basis functions allows us to avoid numerical integrations and to treat accurately the noncentral nature of the scattering process with full allowance for electron exchange. The sum of the two triplet cross sections is found to be in good agreement with the experimental cross section for dissociation of H_2 into 2H. (AIP)

11740 Low-energy scattering of electrons by atomic oxygen. Tambe, B.R.; Henry, R.J.W. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). *Phys. Rev., A;* 13: No. 1, 224-228(Jan 1976).

The method of polarized pseudostates has been used to calculate cross sections for the elastic scattering of electrons by atomic oxygen. These pseudostates are added to the close-coupling expansion to give a polarization potential in agreement with experimental values of polarizability. The resulting elastic cross sections are in good agreement with other theoretical calculations as well as with experiment for energies up to 10 eV. The reactance matrices obtained in this calculation have been used to calculate collision strengths for fine-structure transitions in the ground-state ^3P term for electron temperatures above 5000 degree K. (AIP)

11741 Line broadening of the $3s_5$-2p/subn/ laser transitions of neon. Knutson, J.W. Jr.; Bennett, W.R. Jr. (Dunham Laboratory, Yale University, New Haven, Connecticut 06520). *Phys. Rev., A;* 13: No. 1, 318-325(Jan 1976).

Doppler and collision broadening were studied on six $2p^55s$ yields $2p^53p$ transitions of Ne I. Line-broadening parameters were extracted using the method of least squares in the computer analysis of spontaneous emission profiles transmitted through a scanning plane-parallel Fabry-Perot interferometer. ^{20}Ne-^{4}He and ^{20}Ne-^{20}Ne Lorentz broadening parameters are tabulated, and their temperature dependence summarized. (AIP)

11742 Single-electron Born approximations for charge transfer from multielectron atoms to protons. Omidvar, K.; Golden, J.E.; McGuire, J.H.; Weaver, L. (Theoretical Studies Group, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771). *Phys. Rev., A;* 13: No. 1, 500-503(Jan 1976).

The Born approximation, including the internuclear interaction, is used to compute cross sections for the transfer of one electron from a multielectron atom to an incident proton. When the full internuclear interaction is included, the results lie far above high-energy experimental K-shell data for p + Ar. However, when only enough internuclear interaction is used so that the total projectile-target interaction goes to zero asymptotically in accord with plane-wave functions actually used, fair agreement at high energies is obtained. The latter form of the Born approximation is compared to data on K-shell capture from helium as well as argon, in addition to the simpler approximation of Oppenheimer and of Brinkman and Kramers (OBK), where no internuclear interaction is included. The OBK results typically lie a factor of 2 to 8 above the data, while our Born results are within a factor of 2 of most of the existing high-velocity K-shell data, i.e., with an accuracy comparable to more sophisticated calculations. (AIP)

11743 Transition radiation for the diagnosis of low-energy electron beams. Mahan, A.H.; Gallagher, A. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, Colorado 80302). *Rev. Sci. Instrum.;* 47: No. 1, 81-83(Jan 1976).

Electron bombardment of metallic silver is known to produce "transition radiation," predominantly at 300—450 nm wavelengths. In reported measurements at 15—500 eV impact energies, transition radiation was used to diagnose the shape and time dependence of an rf modulated electron beam. It is suggested that this is a superior target, as opposed to phosphors or gases normally used, to determine instrumental time response functions and electron beam imaging. (AIP)

11744 Chemi-ionization reactions in accelerated uranium—O_2 crossed molecular beams. Young, C.E.; Dehmer, P.M.; Cohen, R.B.; Pobo, L.G.; Wexler, S. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* 64: No. 1, 306-319(1 Jan 1976).

Chemi-ionization and electron transfer reactions in accelerated uranium-atom—oxygen-molecule collisions have been studied by crossed molecular beam techniques: U+O_2yields UO^+_2+e, associative ionization (1); U+O_2yieldsUO^++(O+e), rearrangement (reactive) ionization (2); U+O_2yieldsU^++(O_2+e), electron transfer (3). Cross sections for the three ionization channels were measured as a function of relative collision energy from 0.2 to 60 eV. The thresholds observed for channels (2) and (3), which are closed at thermal energies, are in good agreement with values calculated from thermochemical data. The cross section for associative ionization varied inversely with v/subr/, the relative collision velocity, as predicted for weak autoionizing transitions. With the use of a rough absolute calibration and a 1/v/subr/ extrapolation to lower energies, the UO^+_2 cross section was found to be in agreement with the previously reported value measured with thermal beams. In the case of rearrangement ionization, the cross section rose rapidly at threshold, peaked near the threshold for the electron transfer process, and then declined with increasing collision energy. The electron transfer cross section increased with a power-law dependence of the excess energy above threshold throughout the range investigated. The maximum absolute cross section measured was 1.4×10^{-17} cm^2. The dynamics of ionization processes (2) and (3) were elucidated from the energy dependences of the cross sections and from measurements of the angular and kinetic energy distributions of the product ions. The results support the conclusion that rearrangement ionization proceeds by a "spectator-stripping" mechanism. Both the UO^+ from this reaction and the U^+ from electron transfer are scattered predominantly in the forward direction. (AIP)

11745 Effects of partial cross sections on the energy distribution of slow secondary electrons. Tuckwell, H.C.; Kim, Y. (Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* 64: No. 1, 333-336(1 Jan 1976).

The shapes of the energy distribution of secondary electrons can be predicted for fast incident charged particles by using dipole oscillator strengths in conjunction with the Born formula. Target atoms or molecules may have one or more ionization potentials close to the first one and the corresponding partial photoionization cross sections are sometimes large. Allowance must then be made for the differences in kinetic energies of photoelectrons which leave alternative ionic states. This produces a significant change in the expected secondary electron spectrum at low energies. The photoionization data for NO are analyzed and the predicted shape of the secondary electron energy distribution agrees well with that of the experimental distribution at those secondary electron energies where a comparison is possible. Predicted low energy results from a preliminary analysis for N_2 are also reported. (AIP)

11746 Parameter-variation calculations of e^-H ^{1}S scattering resonances. Perkins, J.F. (U.S. Army Missile Command, Redstone Arsenal, Alabama 35809). *Phys. Rev., A;* 13: No. 2, 622-625(Feb 1976).

A recently proposed anomaly-free averaged Kohn parameter-variation method has been used for calculations of the two lowest ^{1}S resonances in e^-H scattering. Calculated phase shifts at a number of points spanning each resonance can be fitted rather closely with a one-level resonance formula, and the resulting widths are in reasonable agreement with results of other workers. (AIP)

11747 Reply to "Comment on inelastic scattering in atom—distomic molecule collisions. I. Rotational transition in the sudden approximation". Stallcop, J.R. (NASA-Ames Research Center, Moffett Field, California 94035). *J. Chem. Phys.;* 64: No. 3, 1258-1259(1 Feb 1976).

A reply is made to the comments by Pack and it is argued that the assumptions in paper by Stallcop, J. Chem. Phys. 61, 5085 (1974) are valid. (AIP)

11748 Excitation of the Sr and Sr^+ resonance lines by electron impact on Sr atoms. Chen, S.T.; Leep, D.; Gallagher, A. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, Colorado 80302). *Phys. Rev., A;* 13: No. 3, 947-952(Mar 1976).

The relative optical excitation functions and polarizations of the Sr resonance line (4607 A) and of the Sr^+ resonance lines (4078 and 4216 A) have been measured, using crossed electron and strontium-atom beams, for electron energies from the excitation thresholds to 1497 eV. The electron-beam energy resolution was ~ 0.22 eV for energies below The electron-beam energy resolution was ~ 0.22 eV for energies below 13 eV, and the atom beam was optically thin. The excitation functions of the ionic lines were measured relative to that of the atomic resonance line at fixed energies near the maxima of the excitation functions. Using spontaneous-emission branching ratios, this yields the ratios of total excitation cross sections for the atomic and ionic resonance levels (including cascades). The Sr 5 ^1P excitation function has been normalized to Born theory taking account of cascade at 1497 eV, where the energy dependence of the excitation function has converged to the theoretical behavior. The resulting normalized cross sections have been compared with available theoretical calculations and other measurements. The 4607-A polarization function is consistent with the theoretical threshold limit within experimental uncertaintly. (AIP)

ATOMIC AND MOLECULAR THEORY

REFER ALSO TO CITATION(S) 11709, 11719

11749 (LA-tr—75-16) **Introduction to the calculation of the rotation—vibration energy of molecules with spherical symmetry.** Moret-Bailly, J. Translated from *Cah. Phys.;* No. 112, (1959). 26p. Dep. NTIS $4.00.

The calculation of the normal coordinates of XY_6 type molecules is presented and the anharmonic terms of the potential energy and the value of the interaction coefficients of the vibrations and the rotation are deduced from it. The results pertaining to XY_4 type molecules are recalled. (auth)

11750 (LA-tr—75-15) **Interpretation of rotation—vibration spectra of molecules with tetrahedral or octahedral symmetry.** Moret-Bailly, J. Translated from *Cah. Phys.;* No. 130/131, 237-314(1961). 109p. Dep. NTIS $5.50.

The study of rotation-vibration spectra of "spherical tops," molecules, whose main types are methane and sulfur hexafluoride, is presented. It is shown that the general theory of rotation-vibration spectra must be modified for the study of the "spherical tops." The theory of irreducible spherical tensors is generalized so it can be adapted to problems with no revolution symmetry. The general theory is particularized in the case of systems with cubic symmetry. The cubic tensors thus defined are used to write the development up to the third order of the rotation-vibration Hamiltonian of the spherical tops. The matrix elements of this Hamiltonian are calculated in a representation which yields a diagonal energy matrix with respect to the quantum index of orientation of the kinetic momentum in the molecule. The selection rules related to this quantum index are established. Formulas are presented which make it possible to calculate the energies of the three-fold degenerate fundamental transitions by a perturbation method. This theory is applied to the V_4 band of methane, and a satisfactory interpretation of the experimental results is obtained by a calculation brought as far as the third order, involving only seven constants. 44 refs, 13 tables, 4 figs. (GHT)

11751 MS-Xα calculations of polyhedral boron compounds. Preston, H.J.T.; Kaufman, J.J.; Koski, W.S. (Johns Hopkins Univ., Baltimore). *Int. J. Quant. Chem., Symp.;* No. 9, 137-145(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

MS-Xα calculations have been carried out for $B_3H_6^{-3}$, B_3H_9, and 1, 6-$B_4C_2H_6$. Even with the simple muffin-tin approximation, the agreement of the transition state orbital energies with the measured photoelectron spectral ionization potentials for B_3H_9 and 1,6-$B_4C_2H_6$ is as good or better than that found with previous ab initio minimum STO basis LCAO-MO-SCF calculations. The undesirable brittleness of the refractory borides is due to boron polyhedra being joined together in three-dimensional networks by unpaired outpointing electrons at the apices of the polyhedra. It is suggested that a way to ameliorate this brittleness would be to replace some of the boron atoms by carbons (or nitrogens or oxygens) to cut down on the outpointing unpaired electrons and thus to cut down on three dimensional network bonding. It is further hypothesized that such "carborides" or related congeneric species might also have an excellent possibility of being high-temperature superconductors. (auth)

11752 Charge densities and transition densities from the theory of non-closed-shell states and their experimental tests. Sinanoglu, O. (Yale Univ., New Haven). *Int. J. Quant. Chem., Symp.;* No. 9, 155-164(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

It is shown that the proper generalization of the Hartree—Fock wave function to non-closed-shell states is the charge wave function, psi/sub c/, introduced recently by Sinanoglu. This wave function contains all the specifically non-closed-shell type correlation effects which vanish in the closed-shell limit, that is, the internal and semi-internal correlations. The psi/sub c/ gives the "charge-like properties" like electric dipole, quadrupole moments, form factors, hyperfine constants, and the transition densities, hence the allowed and forbidden optical transition probabilities, generalized oscillator strengths, Born cross sections, etc., to good accuracy. The charge wave functions of various ground and excited states are calculated, and from them the above charge-like properties. Unlike the Hartree—Fock values which show large discrepancies, the charge wave function results agree very well with experiments. (auth)

11753 Applications of the Dirac—Slater model to molecules. Ellis, D.E. (Northwestern Univ., Evanston, IL); Rosen, A.; Walch, P.F. *Int. J. Quant. Chem., Symp.;* No. 9, 351-358(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Applications of the Dirac—Slater model to obtain relativistic energy levels and wave functions for molecules are reported. Results are presented for the uranyl ion UO_2^{2+}, calculated by a discrete-variational method using numerical free-atom basis functions. A simple moment polarized generalization of the Slater exchange potential is proposed for treating open-shell systems; results for a 5d atom are compared with corresponding nonrelativistic spin-polarized states. (auth)

11754 Comparison of TFD and Xα methods for molecules and solids. Slater, J.C. (Univ. of Florida, Gainesville). *Int. J. Quant. Chem., Symp.;* No. 9, 7-21(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

The Thomas—Fermi—Dirac (TFD) and multiple-scattering Xα (MS-Xα) methods are compared, for single atoms and for molecules and solids. Both methods are derived from Hamiltonians by variation of the charge density or spin orbitals, respectively, and the Hamiltonians for the two methods differ only in the kinetic energy term. It is pointed out that the main errors in the TFD method arise from the statistical version of the kinetic energy term. The Xα method, which uses the exact kinetic energy term, can be regarded as a modification of the TFD method which removes all the major errors in that method. The Coulomb energy and the exchange-correlation term are identical in both methods. By the example of the TFD method for the carbon atom the various features of both methods are illustrated, and it is pointed out that many features of the calculation of total energy by the Xα method, as described by the overlapping-sphere approach, can be understood better by studying the same problem from the TFD point of view. (auth)

11755 Thomas—Fermi-like analytic independent particle model for atoms and ions. Green, A.E.S.; Garvey, R.H.; Jackman, C.H. (Univ. of Florida, Gainesville). *Int. J. Quant. Chem., Symp.;* No. 9, 43-50(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

The applicability of an independent particle model which was initiated with a particular two-parameter analytic fit to the Thomas—Fermi screening function is further extended. Using the ab initio procedure of Bass, Green, and Wood, the two parameters d and K of the model are determined for all atoms and ions with Z less than or equal to 36, thus extending the determination of Szydlik and Green. The calculated total energies are in excellent agreement with Hartree—Fock results. To a good accuracy K and 1/d may be represented as linear functions of Z - N where N is the total number of electrons and Z the nuclear charge. The slopes and intercepts of the K lines vary fairly smoothly with N, while those of the 1/d lines vary with N in a manner which reflects atomic shell structure. (auth)

11756 Relativistic effects in the Thomas—Fermi atom. Waber, J.T.; Canfield, J.M. (Northwestern Univ., Evanston, IL). *Int. J. Quant. Chem., Symp.;* No. 9, 51-58(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Two methods of applying relativistic corrections to the Thomas—Fermi atom are considered, and numerical calculations are discussed. Radial charge distributions calculated from a relativistic Thomas—Fermi equation agree in gross form with those from more complicated self-consistent calculations. Energy eigenvalues for mercury, as determined from the relativistic Thomas—Fermi solution, are compared with other calculated and experimental values. (auth)

11757 Minimum principles for the Thomas—Fermi—Dirac density. Goodisman, J.; Yonei, K. (Syracuse Univ., NY). *Int. J. Quant. Chem., Symp.;* No. 9, 59-66(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

For an atomic or molecular system we consider the evaluation of the Thomas—Fermi—Dirac energy functional using an electron density whose value and bounding surfaces differ by small amounts from those of the exact Thomas—Fermi—Dirac electron density. The resulting energy is shown necessarily to be higher than the true Thomas—Fermi—Dirac energy. If the displacement of the boundary is not small, the conclusion still holds as long as the boundary of the approximate density lies everywhere outside that of the exact density. (auth)

11758 Approximate SCF MO theory of molecules based on Slater's Xα method. Sambe, H. (Georgia Inst. of Tech., Atlanta). *Int. J. Quant. Chem., Symp.;* No. 9, 95-104(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A new approximate SCF MO theory is constructed for molecular systems based on the Xα method. The proposed theory is suited especially for potential surface calculations. Atomic "core" is separated and no adjustable parameters appear in the theory. Many quantities in the theory can be determined by the undistorted atomic electron densities. Explicit expressions for the separation energy and the model potential are given. (auth)

11759 Amplifiers involving two-photon energy-extraction schemes. Carman, R.L. (Los Alamos Scientific Lab., NM). *Phys. Rev., A;* **12**: No. 3, 1048-1061(Sep 1975).

Amplifiers based on two-photon decay channels of inverted metastable species are examined from a rate-equation and practical-feasibility viewpoint. Approximate analytical solutions, within the rate-equation approximation, predict that resonant parametric generation coupled with anti-Stokes-stimulated Raman scattering (ASRS) is a strong competitor to straight two-photon emission. Expressions for initial growth rates indicate that large linear chromatic dispersion, proper linear absorptions, and resonant enhancements can initially favor two-photon emission, but that ASRS will ultimately dominate in most practical situations if inversion depletion does not occur early. For an amplifier based on degenerate two-photon processes, this situation has led to the proposal of running the system as an odd-harmonic generator, first extracting energy via two-photon emission followed by greater-than-100 percent conversion to the third, fifth, seventh, etc., harmonics. This type of amplifier response has important potential applications for laser-induced thermonuclear fusion as well as for the production of coherent vacuum-uv soft-x-ray systems. An examination of practical constraints provides further analytical relationships between various physical properties of prospective metastable species. Combining these results, several two-photon schemes are pointed out. Based on current technology, atomic iodine, which is inverted to the $^2P_{1/2}$ state, appears to be the best medium for experiments, but other materials, such as atomic oxygen, show greater promise if absolute population inversions of high-density material are created at high efficiency. (auth)

11760 Population difference of two-level atomic system due to a running pulsed field. Nayfeh, M.H. (Oak Ridge National Lab., TN). *J. Appl. Phys.;* **46**: No. 11, 4862-4864(Nov 1975).

The method of multiple scales is used to derive an expression for the population difference in an absorbing atomic system due to a running pulsed field. The main contribution to this expression comes from a quasisteady-state part which has the same functional form as the hole produced by a continuous running field, except that the saturation parameter contains the time dependence of the field. The expression includes also an oscillatory term and a quasisteady term, which decay with a rate that is equal to the inverse of the lifetime of the levels. (auth)

FLUID PHYSICS

REFER ALSO TO CITATION(S) 12104

GENERAL FLUID DYNAMICS

11761 (LA—6108-MS) **Singularity fitting in hydrodynamical calculations II.** Richtmyer, R.D.; Lazarus, R.B. (Los Alamos Scientific Lab., N.Mex. (USA)). Sep 1975. Contract W-7405-eng-36. 16p. Dep. NTIS $4.50.

This is the second report in a series on the development of techniques for the proper handling of singularities in fluid-dynamical calculations; the first was called Progress Report on the Shock-Fitting Project. This report contains six main results: derivation of a free-surface condition, which relates the acceleration of the surface with the gradient of the square of the sound speed just behind it; an accurate method for the early and middle stages of the development of a rarefaction wave, two orders of magnitude more accurate than a simple direct method used for comparison; the similarity theory of the collapsing free surface, where it is shown that there is a two-parameter family of self-similar solutions for $\gamma = 3.9$; the similarity theory for the outgoing shock, which takes into account the entropy increase; a "zooming" method for the study of the asymptotic behavior of solutions of the full initial boundary-value problem; comparison of two methods for determining the similarity parameter delta by zooming, which shows that the second method is preferred. Future reports in the series will contain discussions of the self-similar solutions for this problem, and for that of the collapsing shock, in more detail and for the full range (1, infinity) of γ; the values of certain integrals related to neutronic and thermonuclear rates near collapse; and methods for fitting shocks, contact discontinuities, interfaces, and free surfaces in two-dimensional flows. (auth)

11762 (LA—6191-MS) **Stability of the flow in a shock layer.** White, G.N. (Los Alamos Scientific Lab., N.Mex. (USA)). Dec 1975. Contract W-7405-eng-36. 11p. Dep. NTIS $4.50.

The interior stability of an isothermal shock is studied as an initial value problem for inviscid one- and two-dimensional perturbations and as an initial-boundary value problem for viscous one-dimensional perturbations. The initial steady velocity profile is linear with finite width. Results, obtained from energy integral estimates, indicate stability at low Mach numbers and instability for large Mach numbers. (auth)

MAGNETOHYDRODYNAMICS

REFER ALSO TO CITATION(S) 12127

11763 (ORNL-tr—4098) **Equipment for magnetohydrodynamic studies of free nonsubmerged liquid metal jets.** Dorofeev, V. Translated by M. Gerrard from *Latv. PSR Zinat. Akad. Vestis;* No. 2, 54-56(1967). 3p. Dep. NTIS $3.50.

The general scheme, construction and the experience of running the device with liquid tin jet are discussed. (auth)

11764 (UCRL-Trans—10772) **Calculating a magnetic gasdynamic flow past a body.** Berezin, Yu.A.; Kovenya, V.M. Translated from *Chislennye Metody Mekh. Sploshnoi Sredy;* **4**: No. 4, 15-29(1973). 21p. Dep. NTIS $3.50.

A numerical method of calculating two-dimensional supersonic flow of a viscous, heat-conducting gas around bodies of finite length within the framework of complete equations of single-fluid magnetic gas dynamics is proposed and the results of the solution of this problem are given for the case of a wedge. (auth)

11765 Hall effects on combined free and forced convective hydromagnetic flow through a channel. Mazumder, B.S.; Gupta, A.S.; Datta, N. (Indian Inst. of Tech., Kharagpur, India). *Int. J. Eng. Sci.;* **14**: No. 3, 285-292(1976).

Hydromagnetic free and forced convection in a parallel plate channel permeated by a transverse magnetic field has been considered taking Hall effects into account. When there is a uniform axial temperature variation along the walls, the primary flow shows incipient flow reversal at the upper plate for an increase in temperature along that plate. Similarly flow reversal at the lower plate occurs for a decrease in temperature along that plate. Hall currents are found to exert a destabilizing influence on the flow. The skin-friction for the cross-flow increases with the Hall parameter. The induced magnetic field and the heat transfer characteristics in the flow are also determined. (auth)

SUPERFLUIDITY

11766 Long wavelength excitations and the attenuation of sound in liquid ^{4}He. Ketterson, J.B. (Northwestern Univ., Evanston, IL); Abraham, B.M.; Roach, P.R. pp 3-27 of In Liquid and solid helium. Kuper, C.G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974).

See CONF-740725—.

A brief review is given of current understanding of the behavior of long wavelength excitations in liquid ^{4}He at very low temperatures and their dependence on pressure. A discussion is given of experiments which probe the excitation spectrum; these include inelastic neutron scattering, heat capacity, thermal conductivity, propagation of super thermal phonons, and sound propagation. Special emphasis is given to sound propagation. 20 figures. (auth)

11767 Remarks on the experimental magnetic properties of superfluid ^{3}He. Wheatley, J.C. (Univ. of California, San Diego). pp 97-105 of In Liquid and solid helium. Kuper, C.G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974).

See CONF-740725—.

In a new apparatus, the static magnetism of the B phase has been measured along the line T/sub AB/. The result is that there is no substantive change from the measurements obtained earlier in collaboration with Kojima, Johnson, and Paulson using a different apparatus. 7 figures. (auth)

11768 Hydrodynamic heat flow in superfluid ^{3}He. Johnson, R.T.; Kleinberg, R.L.; Webb, R.A.; Wheatley, J.C. (Univ. of California, San Diego). pp 119-124 of In Liquid and solid helium. Kuper, C.G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974).

See CONF-740725—.

Measurements of the thermal conductivity in superfluid ^{3}He yielded the following conclusions: (1) heat flows hydrodynamically in ^{3}He for temperatures below T/sub c/. (2) The diffuse conductivity in parallel with the hydrodynamic conductivity is too small to measure. 3 figures. (SDF)

11769 Surface states in liquid helium. Woo, C.W. (Northwestern Univ., Evanston, IL). pp 271-285 of In Liquid and solid helium. Kuper, C.G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974).

See CONF-740725—.

From considerations of the surface structure and excitations of pure liquid ^{4}He, we deduce microscopic properties of ^{3}He quasiparticles adsorbed on the surfaces of ^{3}He—^{4}He solutions and predict superfluid transitions in ^{3}He monolayers. 4 figures. (auth)

11770 Some recent experimental work on helium in restricted geometries. Brewer, D.F. (Univ. of Sussex, Brighton, Eng.). pp 315-328 of In Liquid and solid helium. Kuper, C.G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974).

See CONF-740725—.

The properties of adsorbed helium films (mainly ^{4}He) are extensively reviewed. The variation of superfluid onset temperature, superfluid density, critical velocity, and specific heat with film thickness is discussed. The properties of adsorbed ^{3}He are briefly recounted. 10 figures. (auth)

11771 Surface excitations in thin helium films. Washburn, T.E.; Rutledge, J.E.; Mochel, J.M. (Univ. of Illinois, Urbana). pp 351-354 of In Liquid and solid helium. Kuper, C.G. (ed.). New York; John Wiley and Sons, Inc. (1975).

From European topical conference on liquid and solid helium; Haifa, Israel (1 Jul 1974).

See CONF-740725—.

The temperature dependence of third-sound velocity below 0.7°K has been measured in thin helium films. We have observed phonon-like two-dimensional thermal excitations whose density is independent of film thickness for films thinner than 2.8 atomic layers. (auth)

OTHER QUANTUM FLUIDS

REFER ALSO TO CITATION(S) 11766

11772 On the dilute gas two particle density matrices of p—H_2 and He_4. Weres, O. (University of California, Lawrence Berkeley Laboratory, Energy and Environment Division, Berkeley, California 94720). *J. Chem. Phys.*; **64**: No. 2, 848-850(15 Jan 1976).

In the preceding paper we demonstrated that the reduced two- particle density matrix of simple quantum liquids could profitably be re-expressed in terms of a Taylor expansion of its logarithm about the diagonal. In the present publication we examine the Taylor coefficients which arise when the dilute gas two particle density matrix is expanded in this way. In particular, we evaluate the leading coefficients of p-H_2 and He^4 exactly and extend the Wigner—Kirkwood approximation to provided approximate expressions for them. We demonstrate how these approximate expressions may be applied to yield results superior to those yielded by the ordinary Wigner—Kirkwood approximation. In an appendix we demonstrate how the Block equation for the dilute gas two particle density matrix may be reduced to an equivalent closed set of equations for the leading Taylor coefficients. (AIP)

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

REFER ALSO TO CITATION(S) 11372

11773 (LBL—4277) Physics Division annual reports, 1 July 1972—31 December 1974. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1974. Contract W-7405-eng-48. 109p. Dep. NTIS $6.00.

The research of the staff members of the Physics Division of Lawrence Berkeley Laboratory is presented in a descriptive fashion. Extensive lists of publications are included. The presentation is arranged as follows: high-energy physics (experimental physics, Particle Data Center, theoretical physics), nuclear science (heavy-ion research; nuclear structure studies that use mesons; atomic and molecular structure studies with mesons as probe particles; hadronic decay processes; interactions of light nuclei, protons, and antiprotons; collective models of heavy nuclei), molecular science, instrumentation development, data handling, and mathematics and computing (computer science, applied mathematics research). The experimental high-energy physics program dealt with such subjects as the discovery of the psi particles, pp and Kp interactions, antiparticles and hyperons, electromagnetic and weak interactins, lepton-induced reactions, astrophysics and cosmic ray research, and archaeology. (RWR)

11774 Particle data group: growth and operations. Eighteen years of particle physics. Rosenfeld, A.H. (Lawrence Berkeley Lab., CA). *Annu. Rev. Nucl. Sci.*; **25**: 555-598(1975).

A review is given of the growth of particle physics data as it relates to the collection, evaluation, correction, verification, analysis, and distribution by the Particle Data Group. (SDF)

ELECTROMAGNETIC INTERACTIONS

REFER ALSO TO CITATION(S) 11798, 11806

11775 (COO—535-733, pp 68-70) **Double electron—positron pair production by low energy gamma rays.** Ristinen, R.A.; Peterson, R.J.; Cecil, F.E. 1 Nov 1975.

In Technical progress report and proposal for continuation of contract.

11776 Electron—positron inclusive hadron reactions. Barnett, B.A. (Univ. of Maryland, College Park); Atwood, T.; Zorn, G. pp 115-130 of In Theories and experiments in high-energy physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

See CONF-750110—P1.

Some of the preliminary measurements for performing an experiment on e^+e^- interactions are discussed. This experiment was predominantly a single-arm magnetic spectrometer for measuring e^+e^- inclusive cross sections. (JFP)

11777 Experimental test of charge conservation and the stability of the electron. Steinberg, R.I.; Kwiatkowski, K.; Maenhaut, W.; Wall, N.S. (University of Maryland, College Park, Maryland 20742). *Phys. Rev., D*; **12**: No. 9, 2582-2586(1 Nov 1975).

A new experimental lower limit of 5.3×10^{21} years for the mean lifetime of the electron for decay into nonionizing particles is reported. A finite value for this lifetime would have implied a breakdown of the law of charge conservation. The experimental technique consists of a search for the internally-absorbed 11.1-keV

x-ray and Auger-electron cascade which would follow the decay of a Kshell electron in a germanium atom in a high-resolution Ge(Li) detector. (AIP)

11778 Search for new resonances and thresholds in inelastic electron scattering. Cottrell, R.L.A.; Ash, W.; Atwood, W.B.; Coward, D.H.; DeStaebler, H.; Mestayer, M.; Pessard, H.; Prescott, C.Y.; Rochester, L.S.; Sherden, D.J.; Sinclair, C.K.; Taylor, R.E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94306). *Phys. Rev., D;* 13: No. 1, 166-170(1 Jan 1976).

The search for new resonances and thresholds in the hadronic final state X^+ in ep yields e'X has been extended for missing masses from 3 GeV to 5.5 GeV. At a level of roughly 5% of the cross sections, no unexpected structure was found. (AIP)

11779 Measurement of the reaction e^+e^-yields$\gamma\gamma$ in the region of the psi (3684). Hughes, E.B.; Beron, B.L.; Carrington, R.L.; Ford, R.L.; Hilger, E.; Hofstadter, R.; Liberman, A.D.; Martin, T.W.; O'Neill, L.H.; Simpson, J.W.; Resvanis, L.K. (High Energy Physics Laboratory and Department of Physics, Stanford University, Stanford, California 94305). *Phys. Rev. Lett.;* 36: No. 2, 76-79(12 Jan 1976).

In a study of the reaction e^+e^-yields$\gamma\gamma$ in the region of the psi (3684) resonance, no evidence is found for a deviation from quantum electrodynamics. Limits are also set on the decays psi (3684) yields$\pi^o\gamma$, psi (3684) yieldseta$^o\gamma$, and psi (3684) yields$X^o\gamma$, where X^o is a pseudoscalar state in the mass range 2500—3000 MeV which subsequently decays into two γ rays. (AIP)

WEAK INTERACTIONS

11780 Experimental study of the energy spectrum of the π^+ in K^+ yields $\pi^+\pi^o\pi^o$ decay. Sheaff, M. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). *Phys. Rev., D;* 12: No. 9, 2570-2581(1 Nov 1975).

A sample of 5635 π^+ with kinetic energies between 8 and 50 MeV was obtained from K^+ yields $\pi^+\pi^o\pi^o$ decays in the ANL—Michigan 40-in. heavy liquid bubble chamber filled with propane. For these the energy dependence was well described by a linear spectrum of the form mod^2 $M = 1 + g[(s_3 - s_o)/m^2$/sub π^+/], where $g = 0.602 +- 0.021$. No evidence was found for a quadratic term significantly different from 0. When the five conventional test quantities for the isospin selection rules were formed using the value of g from this experiment and current world averages for the other K yields 3π decay parameters, it was found that there was significant evidence for abs. value $\Delta I = 3/2$ amplitudes into both $I = 2$ and $I = 1$ final states. These experimental values are in good agreement with theoretical predictions for them obtained in models which satisfy the current-algebra relation at the soft-pion points and include abs. value $\Delta I = 3/2$ as well as abs. value $\Delta I = 1/2$ amplitudes. (AIP)

11781 Isospin properties of single-pion production by neutrinos. Barish, S.J.; Cho, Y.; Derrick, M.; Dombeck, T.; Hyman, L.G.; Musgrave, B.; Schreiner, P.; Singer, R.; Smith, R.P.; Swanson, D.; Yuta, H.; Barnes, V.E.; Carmony, D.D.; Garfinkel, A.F. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* 36: No. 4, 179-183(26 Jan 1976).

Results are presented on the three single-pion production reactions vpyields$\mu^-p\pi^+$, vnyields$\mu^-n\pi^+$, and vnyields$\mu^-p\pi^o$. Measurements were made from threshold to a neutrino energy of 1.5 GeV using the Argonne National Laboratory 12-ft bubble chamber filled with hydrogen and deuterium and exposed to a broad-band neutrino beam. In addition to a resonant isospin $T=3/2\pi N$ amplitude, a large $T=1/2$ amplitude is found as predicted by Adler. (AIP)

11782 Determination of the G parity and isospin of psi (3095) by study of multipion decays. Jean-Marie, B.; Abrams, G.S.; Boyarski, A.M.; Breidenbach, M.; Bulos, F.; Chinowsky, W.; Feldman, G.J.; Friedberg, C.E.; Fryberger, D.; Goldhaber, G.; Hanson, G.; Hartill, D.L.; Kadyk, J.A.; Larsen, R.R.; Litke, A.M.; Luke, D.; Lulu, B.A.; Luth, V.; Lynch, H.L.; Morehouse, C.C.; Paterson, J.M.; Perl, M.L.; Pierre, F.M.; Pun, T.P.; Rapidis, P.; Richter, B.; Sadoulet, B.; Schwitters, R.F.; Tanenbaum, W.; Trilling, G.H.; Vannucci, F.; Whitaker, J.S.; Winkelmann, F.C.; Wiss, J.E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev. Lett.;* 36: No. 6, 291-294(9 Feb 1976).

We present here a measurement of six branching ratios of psi (3095) corresponding to the decays psi (3095) yieldsrhoπ, $2(\pi^+\pi^-)$, $2(\pi^+\pi^-)1\pi^o$, $3(\pi^+\pi^-)$, $3(\pi^+\pi^-)1\pi^o$, and $4(\pi^+\pi^-)1\pi^o$. From this study, the isospin and G-parity quantum numbers are found to be I/supG/=0$^-$. (AIP)

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 11803

11783 (COO—3533-64(Vol.1), pp I.49-I.52) **Antiproton—deuteron annihilations at low energies.** Tzanakos, G. (Syracuse Univ., NY). 1975.

From 4. international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In Proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume I. Chapters 1—4.

Antiproton annihilations in deuterium below 450 MeV/c, including at rest, in the 30'' bubble chamber are studied. There are 300^{o}K photographs containing 1.5×10^6 annihilations 60 percent of which occur above 260 MeV/c (in-flights) while most of the remaining occur at rest. Cross sections and branching ratios are discussed. (auth)

11784 (COO—3533-64(Vol.1), pp I.84-I.103) **Search for substructure in anti pp total cross section in the 2200 MeV mass region.** Peaslee, D.C. (Australian National Univ., Canberra); DeMarzo, C.; Guerriero, L. 1975.

From 4. international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In Proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume I. Chapters 1—4.

The anti pp total cross section is measured in an apparatus with a small target and high resolution beam in order to supplement previous work by looking for narrow structure that might be hidden in broad-mass bins. One could set limits on the partial widths of bosons coupling to the anti pp system. The product of an unknown production cross section and a partial width was determined. From the data the existence of resolution-sized structure above the smooth fit with the product of cross section and width greater than 7 MeV mb. It can be shown that a Breit—Wigner resonance of spin J coupled to the anti pp system in this region must have partial width GAMMA/sub anti pp/ less than 1.8/(2J + 1) MeV. Also it is found that the broad enhancement observed in the anti pp total cross section persists without modification in an observation with mass resolution six times that of previous work. (JFP)

11785 (COO—3533-64(Vol.1), pp II.21-II.26) **Anti pp yields $2\pi^o$ (200-700)MeV/c.** Dris, M.A. (Univ. of Pittsburgh). 1975.

From 4. international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In Proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume I. Chapters 1—4.

The annihilation mode anti pp yields $2\pi^o$ for antiprotons reacting with liquid hydrogen and having momenta (200 to 700) MeV/c is examined. The angular distributions are forward peaked and the ratio $2\pi^o/\pi^+\pi^-$ does not change appreciably from that at rest. (auth)

11786 (COO—3533-64(Vol.1), pp II.27-II.43) **Angular distributions for anti pp yields $\pi^o\pi^o$ between 1.2 and 2.0 GeV/c.** DeMarzo, C. (Bari Univ., Italy); Guerriero, L.; Posa, F. 1975.

From 4. international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In Proceedings of the IV international symposium on nucleon-antinucleon interactons. Volume I. Chapters 1—4.

Preliminary angular distributions are presented for anti pp yields $\pi^o\pi^o$ interactions at six laboratory momenta between 1.0 and 2.0 GeV/c. Integrated cross sections and Legendre coefficients are also shown. (JFP)

11787 (COO—3533-64(Vol.1), pp II.44-II.53) **Preliminary results for anti pp yields π^oeta^o between 1.2 and 2.0 GeV/c (also anti pp yields eta^{o}eta^o at two moments).** DeMarzo, C. (Bari Univ., Italy); Guerriero, L.; Posa, F. 1975.

From 4. international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In Proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume I. Chapters 1—4.

The discussion of the preliminary results for anti pp yields π^oeta^o, eta^{o}eta^o includes the angular distribution, various total and differential cross sections, and the Legendre coefficients. (JFP)

11788 (COO—3533-64(Vol.1), pp III.13-III.45) **Pionic annihilations of 0.40—0.92 GeV/c antiprotons on neutrons.** Caro, D.E.; Gold, E.; Klein, A.G.; Opat, G.I.; Wignall, J.W.G. (Univ. of Melbourne). 1975.

From 4. international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In Proceedings of the IV international symposium on nucleon—antinucleon interactions. Volume I. Chapters 1—4.

Research on anti pn annihilations in the anti p momentum range 0.40 to 0.92 GeV/c is summarized. Mostly annihilations into three and four pions are considered, but also some preliminary data on other pionic annihilation channels are considered. Included are cross sections and branching ratios, the reaction anti pn yields 2 π^- pi^+, the reaction anti pn yields 3 pi^- pi^+ π^0, and G parity tests and rho — ω interference. (JFP)

11789 (COO—3533-64(Vol.1), pp III.47-III.58) **Pion multiplicities for intermediate energy anti pp annihilations.** Burns, R.R.; Condon, P.E.; Donahue, J.; Mandelkern, M.A.; Price, L.R.; Schultz, J.; Smith, D.W. (Univ. of California, Irvine). 1975.

From 4. international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In Proceedings of the IV international symposium on nucleon—antinucleon interactions. Volume I. Chapters 1—4.

Results for pion multiplicities and correlation coefficients near 1 GeV/c are reported for anti pp annihilations at 0.686 to 1.098 GeV/c. The topological cross sections and pion multiplicities and correlations are discussed. (JFP)

11790 (COO—3533-64(Vol.1), pp III.68-III.87) **Multi-pion final states in the T(2190) region.** Handler, T. (Rutgers-the State Univ., New Brunswick, NJ); Jacques, P.; Jones, M. 1975.

From 4. international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In Proceedings of the IV international symposium on nucleon—antinucleon interactions. Volume I. Chapters 1—4.

Results of an analysis of four and five pion final states in anti pp interactions at 1.22 to 1.35 GeV/c are summarized. Included are resonance percentages, mass distributions, angular distributions, and polar equatorial asymmetries. (JFP)

11791 (COO—3533-64(Vol.1), pp III.115-III.131) **Charged-particle multiplicities in 100 GeV/c anti pp interactions.** Whitmore, J. (Michigan State Univ., East Lansing); Morris, W.; Oh, B.Y. 1975.

From 4. international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In Proceedings of the IV international symposium on nucleon—antinucleon interactions. Voiume I. Chapters 1—4.

Preliminary results are presented on the topological cross sections produced in antiproton-proton interactions from an exposure of the Fermilab 30-inch bubble chamber to a 100 GeV/c enriched anti p beam. The anti pp inelastic cross section is determined to be sigma/sub ine/ = 34.65 +- 0.23 mb, and the average inelastic charged particle multiplicity is [n/sub c/] = 6.74 +- 0.11. (auth)

11792 (COO—3533-64(Vol.1), pp IV.1-IV.8) **Study of double scattering effect in antiproton—deuteron annihilation.** Zemany, P.D. (Michigan State Univ., East Lansing). 1975.

From 4. international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In Proceedings of the IV international symposium on nucleon—antinucleon interactions. Volume I. Chapters 1—4.

The double scattering process in the deuteron is investigated for the reaction anti pd yields p/sub s/ + mesons. About 30 percent of the apparent anti pn annihilations are involved in double scattering. A model which describes the properties of protons emerging from apparent anti pn annihilations is presented. (auth)

11793 (COO—3533-64(Vol.2), pp VI.10-VI.16) **Nuclear absorption of slow antiprotons.** Condo, G.T. (Univ. of Tennessee, Knoxville); Bugg, W.M.; Hart, E.L.; Cohn, H.O.; McCulloch, R.D. 1975.

From 4. international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In Proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume 2. Chapters 5—8.

Because of the existence of the Y/sub 0/* the K^-p threshold, the analysis of slow K^- absorption is difficult. This experiment using anti p absorptions is an attempt to obviate this difficulty. The ratio of anti pn to anti pp absorption for the four elements used in the experiment which are carbon, titanium, tantalum, and lead, is measured. (JFP)

11794 (COO—3533-64(Vol.2), pp VII.1-VII.41) **Anti p and anti n facilities at the BNL AGS.** Lowenstein, D.I. (Brookhaven National Lab., Upton, NY). 1975.

From 4. international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In Proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume 2. Chapters 5—8.

The typical AGS operating conditions are outlined. The status and availability of beams at the end of FY 75 and a brief synopsis of the experiments that have gotten beam time during the present year are given. New experiments in FY 76 that will be using anti p beams are also outlined. (CES)

11795 (IS-T—705) **Proton—proton interactions at 200 and 300 GeV/c.** Ogino, F. (Ames Lab., Iowa (USA)). Jan 1976. Contract W-7405-eng-82. 155p. Dep. NTIS $6.75.

Thesis. Submitted to Iowa State Univ.

The reactions pp yields pp π^+pi^- and pp yields pp$\pi^+\pi^-\pi^+\pi^-$ at 200 and 300 GeV/c were investigated using the Fermilab 30-inch hydrogen bubble chamber and downstream wide-gap spark chambers. This analysis is based upon approximately 9500 4-pronged and 6-pronged events. The cross sections were consistent with pomeron dominance for these reactions. The final state pp $\pi^+\pi^-$ is dominated by single diffractive dissociation, whose features are quite similar to those observed at low energy. A strong signal for double excitation was seen in the pp $\pi^+\pi^-\pi^+\pi^-$ final state and pomeron factorization was found to be satisfied. In the pp $\pi^+\pi^-$ final state, 66 events passed the criterion of double pomeron exchange defined by D. M. Chew. However, these events were found to be severely contaminated by diffractive events. The two-particle exclusive azimuthal correlations agreed well with the prediction of a photostatistical model. (auth)

11796 **Further search for massive long-lived particles produced by 400-GeV protons.** Frankel, S.; Frati, W.; Resvanis, L.K.; Yang, W.; Nezrick, F. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). *Phys. Rev., D;* **12**: No. 9, 2561-2564(1 Nov 1975).

We report the negative result of a search for the decay products of long-lived particles having lifetimes in the range 50 milliseconds to 10 hours. The upper limit for the "cross section for production and capture" of such particles in a 33-cm aluminum target irradiated with 400-GeV protons is set at less than 10^{-34} cm^2. (AIP)

11797 **Measurement of the spin—spin correlation parameter C/sub N/ in proton—proton scattering at 6 GeV/c.** Hicks, G.; Miller, D.; Wilson, C.; Bridges, D.; Giese, R.; Hill, D.; Miller, R.; Nield, K.; Rynes, P.; Sandler, B.; Yokosawa, A. (Physics Department, Northwestern University, Evanston, Illinois 60201). *Phys. Rev., D;* **12**: No. 9, 2594-2596(1 Nov 1975).

As part of a program to determine proton—proton elastic-scattering amplitudes, we have measured the spin—spin correlation parameter C/sub NN/ at 6 GeV/c. Measurements were made over the abs. value t range of 0.08 to 1.4 $(GeV/c)^2$ by using a polarized beam and a polarized target at the Argonne National Laboratory Zero Gradient Synchrotron. (AIP)

11798 **Pion distributions in highly inelastic pp yields pπX at 28.5 GeV/c and comparisons with ep yields eπX.** Anderson, E.W.; Clifford, T.S.; Lazarus, E.; Schreiner, W.N.; Schuberlin, P.; Turkot, F.; Gutay, L.J.; Collins, G.B.; Ficenec, J.R.; Stringfellow, B.C. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., D;* **12**: No. 11, 3375-3385(1 Dec 1975).

We have measured the π^- yield in pp yields pπ^-X relative to the cross section for pp yields p + MM at 28.5 GeV/c. The pion distributions are parameterized in terms of x, p/sub perpendicular/^{2}, and phi in the rest frame of the missing mass, MM. The distributions are compared with the corresponding electroproduction case for $-0.1 < x < 0.6$ at the same missing mass and four-momentum transfer to the scattered beam particle. We find striking similarities: (1) The phi distributions are flat for the proton case as in electroproduction, (2) the slopes of the transverse momentum distributions are the same as in electroproduction, and (3) the x distributions have the same shape as in electroproduction. (AIP)

11799 **Measurement of the depolarization parameter in elastic proton—proton scattering at 3 and 6 GeV/c.** Abshire, G.W.; Bryant, G.W.; Corcoran, M.; Crittenden, R.R.; Gray, S.W.; Heinz, R.M.; Hendry, A.W.; Neal, H.A.; Rust, D.R. (Department of Physics, Indiana University, Bloomington, Indiana 47401). *Phys. Rev., D;* **12**: No. 11, 3393-3398(1 Dec 1975).

Results are presented from an experiment designed to make the first systematic study of the depolarization parameter in elastic proton—proton scattering at high energies. Measurements were made at 3.0 and 6.0 GeV/c at abs. value t values extending to 1.7 $(GeV/c)^2$ at the higher momentum. A high-intensity unpolarized proton beam was incident on a polarized proton target and the polarization of the elastically scattered recoil protons was determined with a carbon analyzer. The results are discussed in the framework of optical and exchange models. (AIP)

11800 **phi (1020) yields rho (770) π decay.** Kalbfleisch, G.R.; Strand, R.C.; Chapman, J.W. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., D;* **13**: No. 1, 22-24(1 Jan 1976).

The phi (1020) yields 3π decay appears to be dominated by rhoπ final states. (AIP)

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 12079

11801 (ANL/HEP/PR—75-59) **K/sub L/°p interactions at 550 MeV/c.** Cho, Y.; Derrick, M.; Miller, R.J.; Smith, R.P.; Engler, A.; Keyes, G.; Kraemer, R.W.; Schlereth, J.; Tanaka, M. (Argonne National Lab., Ill. (USA); Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). 1975. 14p. Dep. NTIS $3.50.

Differential and channel cross sections and hyperon polarizations are presented for the reactions K°/sub L/p yields K°/sub S/p, π^+ A^0, and π^+ Σ^0 at an average beam momentum of 550 MeV/c. These data provide constraints on KN and anti KN amplitudes obtained from charged kaon reactions and reject one of the S = +1, I = 0 and one of the S equals -1, I = 1 phase shift solutions. (auth)

11802 (COO—2197-34) **Pion—nucleon interaction and mesonic atoms. Progress report, 1 February 1975—31 January 1976.** Rebka, G.A. Jr.; Kunselman, R. (Wyoming Univ., Laramie (USA)). 1976. Contract E(11-1)-2197. 18p. Dep. NTIS $3.50.

Research on pion—nucleon interactions and mesonic atoms is summarized. (JFP)

11803 (COO—3533-64(Vol.1), pp III.60-III.61) **Possible S(1930) enhancement in anti pp yields anti nnπ near threshold.** Burns, R.R.; Condon, P.E.; Donahue, J.; Mandelkern, M.A.; Michelotti, L.; Price, L.R.; Schultz, J. (Univ. of California, Irvine). 1975.

From 4. international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In Proceedings of the IV international symposium on nucleon—antinucleon interactions. Volume I. Chapters 1—4.

Proton—antiproton interactions at 0.943 to 1.098 GeV/c were studied in the final states anti pp π^0, anti pn π^+,, anti np π^-. The main concern is to obtain results for comparison with current algebra predictions for soft pion emission. The invariant-mass plots are discussed. An enhancement is found which may be due to the S(1930). The limited statistics suggest the enhancement to be in I = 1. (JFP)

11804 Analysis of the reactions π^+d yields p/subs/p$\pi^+\pi^+\pi^-\pi^-$ and π^+d yields p/subs/p$\pi^+\pi^+\pi^-\pi^-\pi^0$ at 13.1 GeV/c. Badewitz, R.C.; Miller, D.H.; Palfrey, T.R. (Physics Department, Purdue University, West Lafayette, Indiana 47907). *Phys. Rev., D;* **12**: No. 9, 2535-2544(1 Nov 1975).

We have studied the properties of the reactions π^+d yields p/sub s/p$\pi^+\pi^+\pi^-\pi^-$ and π^+d yields p/sub s/p$\pi^+\pi^+\pi^-\pi^-\pi^0$ at 13.1 GeV/c with a sensitivity of 9.7 events/μb. We find the cross sections for these reactions to be 490 +- 30 μb and 590 +- 50 μb, respectively. There is significant resonance production in the two reactions, but particular final states are difficult to isolate because of the restricted phase space and permutational complexity. The general kinematic features of the reactions are presented, and a binary longitudinal-phase-space analysis is applied to the data. By using these techniques the cross sections for the most important contributions to the final states are determined. It is found that significant resonance production occurs in the first reaction, but very little in the second reaction with the additional π^0. (AIP)

11805 Inclusive π^0 production in π^-p interactions at 5 GeV/c. Burleson, G.; Hicks, G.; Wilson, C.L.; Droege, T.; Koehler, P.F.M.; Novey, T.B.; Sandler, B.; Spinka, H.M.; Yokosawa, A.; Ferbel, T. (Northwestern University, Evanston, Illinois 60201). *Phys. Rev., D;* **12**: No. 9, 2557-2560(1 Nov 1975).

We have measured the cross section for the reaction π^-p yields π^0 + anything at an incident momentum of 5 GeV/c. The two γ rays from π^0 decays were detected using a 150-element lead-glass hodoscope array. A comparison is given of the inclusive π^0 spectrum from hydrogen (obtained through a subtraction of CH_2 and C target data) with π^0 production from C and Cu. (AIP)

11806 Production of the Δ (1950) by one-pion exchange in π^+p interactions at 13 GeV/c. Gaidos, J.A.; Miller, D.H. (Physics Department, Purdue University, West Lafayette, Indiana 47907). *Phys. Rev., D;* **12**: No. 9, 2565-2569(1 Nov 1975).

We have observed the production of high-mass I = 3/2 baryon resonances in π^+p interactions at 13 GeV/c. The most prominent of these is found to be the F_{37} Δ(1950). It is produced by one-pion exchange and the data are well described by on-shell π^+p phase shifts. Decays into pπ^+ and p$\pi^+\pi^0$ are observed, and the Δ(1950) is found to have a mass 1.880 +- 0.010 GeV and width of 0.180 +- 0.030 GeV with a production cross section of 43 +- 4 μb. (AIP)

11807 Reaction K^- + p yields $\Lambda + \pi^0$ from 1647 to 1715 MeV. Ponte, R.A.; Hertzbach, S.S.; Button-Shafer, J.; Yamamoto, S.S.; Hart, E.L.; Rice, R.M.; Bacastow, R.B.; Fung, S.Y. (University of Massachusetts, Amherst, Massachusetts 01002). *Phys. Rev., D;* **12**: No. 9, 2597-2609(1 Nov 1975).

This paper contains the results of a study of the reaction K^-p yields $\Lambda\pi^0$ in the center-of-mass-system-energy region of 1647 to 1715 MeV. An energy-dependent partial-wave analysis was performed in this channel. Two allowable solutions were obtained. The first solution in this region contains the D_{13} [t = 0.08 +- 0.01, Γ (E/sub R/) = 44 +- 11 MeV, and E/sub R/ = 1671 +- 3 MeV] partial wave as the only resonant amplitude; the second solution contains both the P_{11} [t = 0.16 +- 0.01, Γ (E/sub R/) = 81 +- 10 MeV, and E/sub R/ = 1671 +- 2 MeV] and the D_{13} [t = 0.17 +- 0.01, Γ (E/sub R/) = 76 +- 5 MeV, and E/sub R/ = 1655 +- 2 MeV] partial wave as resonant. (AIP)

11808 Study of K^+d elastic scattering in the region of 600 to 900 MeV/c. Sakitt, M.; Skelly, J.; Thompson, J.A. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., D;* **12**: No. 11, 3386-3392(1 Dec 1975).

Measurements of the differential cross section for the coherent elastic scattering process K^+d yields K^+d are presented at four momenta from 600 MeV/c to 890 MeV/c for 0.03 < abs. value t < 0.25 $(GeV/c)^2$. Comparisons are made with previous work and with predictions from partial-wave analyses. (AIP)

11809 Differential cross section for π^-pyieldseta°n at 6.0 GeV/c. Shaevitz, M.H.; Reay, N.W.; Reibel, K.; Stanton, N.R.; Edwards, K.W.; Luxton, G.; Abolins, M.A.; Sidwell, R.A.; Dankowych, J.A.; Luste, G.J.; Martin, J.F.; Prentice, J.D. (Physics Department, The Ohio State University, Columbus, Ohio 43210). *Phys. Rev. Lett.;* **36**: No. 1, 5-8(5 Jan 1976).

The differential cross section for π^-pyieldseta°n has been measured at 6.0 GeV/c from 6730 very clean events in which the decay etayields$\pi^+\pi^-\pi^0$ was detected. The high statistics reveals a sizable forward turnover, implying a dominance of the helicity-flip amplitude. A precisely determined A_2 trajectory, linear for vertical-bartvertical-bar<1.0$(GeV/c)^2$, is found from combining our data with those at energies up to 101 GeV. (AIP)

11810 High-statistics study of ω^0 production. Shaevitz, M.H.; Reay, N.W.; Reibel, K.; Stanton, N.R.; Edwards, K.W.; Luxton, G.; Abolins, M.A.; Sidwell, R.A.; Dankowych, J.A.; Luste, G.J.; Martin, J.F.; Prentice, J.D. (Physics Department, The Ohio State University, Columbus, Ohio 43210). *Phys. Rev. Lett.;* **36**: No. 1, 8-11(5 Jan 1976).

Results are presented from a study of π^-pyieldsω^0n at 6.0 GeV/c based on 28 000 events from a charged and neutral spectrometer. Background under the ω^0 is only 7%, a large improvement over deuterium—bubble-chamber work. Density matrix elements, projected cross sections, and effective trajectories for natural and unnatural exchanges are presented. (AIP)

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

REFER ALSO TO CITATION(S) 11773

GENERAL

REFER ALSO TO CITATION(S) 11907, 11908, 11911

11811 (ANL/HEP/PR—76-03) **Intercepts and residues of Regge poles in a stochastic-field multiparticle theory.** Arnold, R.C. (Argonne National Lab., Ill. (USA)). Jan 1976. Contract W-31-109-Eng-38. 16p. Dep. NTIS $3.50.

A dynamical theory of multiparticle amplitudes, based on a functional integral representation embodying collective long-range correlations, is applied to the calculation of Regge intercepts and residues. Poles arising in conventional multiperipheral models will characteristically be modified in three ways: promotion, renormalization, and a proliferation of dynamical secondary trajectories, reminiscent of dual models. (auth)

11812 (CNRS-CPT—74-P-639, pp 125-147) **Quark confinement.** Wilson, K.G. (Cornell Univ., Ithaca, NY). 1975.

From Colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In Recent progress in Lagrangian field theory and applications.

A model of confined quarks is presented. It involves an abelian (or nonabelian) gauge field coupled to a quark field. The theory is quantized on a discrete space-time lattice. It shows quark confinement for strong coupling. Specifically, for strong coupling isolated quarks have infinite mass and quark-antiquark pairs with a large separation r have an energy proportional to r. The theory has

local gauge invariance as an exact symmetry in strong coupling. The strong coupling theory is far from covariant due to the lattice. (auth)

11813 Monopole strings and charmonium. Balachandran, A.P. (Syracuse Univ., New York); Ramachandran, R.; Schecter, J.; Wali, K.C.; Rupertsberger, H. pp 341-347 of In Theories and experiments in high-energy physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

See CONF-750110—P1.

We show that the strength of the potential which varies as the distance between quarks can be related to the universal Regge slope parameter α'. This relation is in excellent agreement with the phenomenological analysis of the newly discovered resonances psi(3.1) and psi(3.7) by Eichten et al.

11814 Fixed past and uncertain future: a single-time covariant quantum particle mechanics. Noyes, H.P. (Stanford Univ., CA). *Found. Phys.*; **5**: No. 1, 37-43(Mar 1975).

A covariant quantum mechanics for systems of finite-mass particles at finite energy follows from interpreting as Wick—Yukawa fluctuations in particle number the quantum fluctuations which are needed by Phipps to understand measurement theory and by Gyftopoulos to understand the second law of thermodynamics. The dynamical one-variable equations require as input the (N - 1)-particle transition matrices and an N—N vertex or coupling constants at three-particle vertices. (auth)

11815 Analysis of a new quark model of hadrons. Harari, H. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Ann. Phys. (N.Y.)*; **94**: No. 2, 391-416(Oct 1975).

A detailed analysis of a new quark model is presented, which proposes an antitriplet of new Heavy quarks in addition to the familiar u,d, and s quarks. The suggestion of three new quarks is motivated by the existence of three psi-particles and by the observed value of $R=\sigma$ ($e+e^-$ yieldshadrons)/σ (e^+e^- yields$\mu^+\mu^-$). It is shown that this is the only model with three new quarks that is consistent with R~5 and with the relative leptonic widths of the psi-particles. The structure of the weak currents in the model prevents absolute $\Delta S = 1$ neutral currents in a natural way. A spectrum of Heavy mesons and baryons is predicted and their decay modes, production, and experimental search are discussed. Radiative decays of psi' (3700) into positive parity psi-like states, which are predicted by the Charm scheme and are not found, are not predicted in this model. However, the hitherto unobserved pseudoscalar psi-like particles predicted by all qg schemes are also predicted. (AIP)

11816 Colored magnetic monopoles. Eguchi, T. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.). *Phys. Lett., B*; **59**: No. 1, 73-78(13 Oct 1975).

Dirac's theory of magnetic monopoles is extended to the case of non-Abelian color gauge groups. The exact classical solution is obtained by making use of the gauge-independent method of a Yang-Mills field. The case of broken gauge symmetry is also briefly discussed. (NL)

11817 Is psi' (3700) a radial excitation of psi (3100) . Kang, J.S.; Schnitzer, H.J. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). *Phys. Rev., D*; **12**: No. 9, 2791-2797(1 Nov 1975).

The proposal that psi'(3700) and psi''(4200) are radial excitations of the psi(3100) charmed-quark—antiquark bound state is reexamined within the context of linear-potential models. If the interaction energy per unit length is universal, this assignment of psi' and psi'' must be retained. If this potential differs for each system, then one may abandon this assignment of psi' and psi'' at the expense of making the psi system relativistic and the charmed-quark mass light. A harmonic-oscillator model is also considered, with substantially the same conclusions. (AIP)

11818 Pomeron-Reggeon relationship according to the topological expansion. Chew, G.F.; Rosenzweig, C. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., D*; **12**: No. 12, 3907-3920(15 Dec 1975).

The nature of the Pomeron and related effects are studied within the framework of Veneziano's topological expansion. At the second, or cylinder, level it is found that no new poles are generated but that first-level (planar) poles with $I = 0$ are shifted by the cylinder, the shifts being in opposite directions for positive and negative charge conjugation. The planar f, in particular, is shifted upward and may be interpreted near $t = 0$ as the Pomeron: with couplings lying roughly midway between the ideal mixing of a planar f and an SU_3 singlet. The Pomeron intercept and couplings (mixing coefficients) together with corresponding intercepts and couplings for ω, f ', and phi are semiquantitatively related through a single parameter to the properties of rho-A_2. In the positive-t physical-particle region corresponding relations successfully correlate the breaking of the Iizuka-Okubo-Zweig rule to the rho-ω mass difference. Comparison of the cylinder shift in this large-t region to that near $t = 0$ reveals the phenomenon of "asymptotic planarity": the cylinder perturbation dying out rapidly with increasing t. It is pointed out that the small Pomeron slope as well as certain physical effects attributed in field theory to asymptotic freedom are consequences of asymptotic planarity. (AIP)

11819 Relativistic bound-state models with quasifree constituent motion. Blaha, S. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853). *Phys. Rev., D*; **12**: No. 12, 3921-3937(15 Dec 1975).

Prototype relativistic bound-state models are considered which avoid normalization and spectral problems usually associated with such models. A novel approach based on the use of hyperboloidal coordinates allows us to take advantage of an attractive angular-momentum-like term in D'Alembertian to obtain kinematic binding in the timelike region of the relative-coordinate Minkowski space. Besides allowing for a type of free quark behavior within the bound state this feature eliminates the spectral problem. We develop a half-space harmonic-oscillator model with a positive-definite, almost linear spectrum. (AIP)

11820 Multiparticle production in Reggeon field theory. Bartels, J.; Rabinovici, E. *Phys. Rev., D*; **12**: No. 12, 3938-3962(15 Dec 1975).

The concept of Reggeon field theory (RFT) is applied to particle production in the multi-Regge region. For processes with repeated Pomeron (P) exchange the high-energy behavior of the production cross sections σ/subn/(s) is calculated and it is found that σ/subn/(s) ~ σ/sub el/(s) ~ $(\ln s)^{-3/8}$ for every n. It is then shown that s-channel unitarity constraints are respected: in the absence of P cuts these processes are known to violate the Froissart bound (Finkelstein-Kajantie problem). It is shown that the inclusion of P cuts in our RFT model solves this problem, provided the P-particle-P vertex is not large. Furthermore, it is demonstrated that the way in which s-channel unitarity is restored does not lead to decoupling problems. Finally, particle production with a secondary Reggeon exchange is considered. It is found that the σ/subn/(s) have qualitatively the same behavior as in the absence of P cuts. (AIP)

11821 Phase transitions of second and zero kind in high-energy physics: A phenomenological field-theoretical approach. σ model and superfluidity of hadronic matter. Eliezer, S.; Weiner, R.M. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev., D*; **13**: No. 1, 87-94(1 Jan 1976).

The temperature concept of Fermi, Landau, and Hagedorn associated with the energy of an elementary-particle reaction is introduced into the thermodynamics of field theory constructed by Weinberg for external temperature. For weak and electromagnetic interactions this implies that the phase transitions predicted within a unified gauge theory of electromagnetic and weak interactions should be looked for in elementary-particle interactions at very high energies (cosmic rays). The experimental observation of these effects which might include, e.g., conservation of strangeness in weak interactions will constitute one of the most clear-cut confirmations of the unified gauge theory. A phenomenological field theory at finite temperature is formulated and all the relevant thermodynamical quantities (thermodynamical potential, pressure, entropy, energy, specific heat, and velocity of sound) are derived. Two possible types of phase transitions are considered, namely of second order and of zero order (Hagedorn type). The implications of phase transitions in strong interactions are discussed for the momentum distribution of secondaries. In the particular case of the σ model a phase transition of the second kind induced by the energy of the reaction and a phonon-like excitation spectrum for the pion cloud inside the nucleon in the spontaneously-broken-symmetry phase is found, giving support to the idea that hadronic matter has superfluid properties. This leads to scaling effects at low excitation energies in scattering reactions on nucleons. The broken symmetry is restored at a critical temperature. Above T/subc/ the parton masses vanish, which leads again to scaling. Conservation of axial-vector currents is found to hold in both phases. In the T > T/subc/ phase chiral multiplets are expected. (AIP)

11822 Dynamical calculation of the A_1. Brayshaw, D.D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev. Lett.*; **36**: No. 2, 73-76(12 Jan 1976).

A relativistic three-body theory previously used to generate the ω has been applied to the 1^+ state of three pions. An A_1 resonance pole is produced with M/subA/$_1$=1160 MeV, Γ/2=90 MeV, but there is no associated phase variation of the amplitude. (AIP)

ELECTROMAGNETIC INTERACTIONS

REFER ALSO TO CITATION(S) 11852, 11863, 11866

11823 (COO—3533-64(Vol.2), pp V.22-V.41) **Annihilation of e^+e^- and anti pp statistical model considerations.** Margolis, B. (McGill Univ., Quebec). 1975.

From 4. international symposium on nucleon antinucleon interactions; Syracuse, New York, USA (2 May 1975).

In Proceedings of the IV international symposium on nucleon-antinucleon interactions. Volume 2. Chapters 5—8.

A comparison was previously made of the e^+e^- annihilation data for multiplicities and $\pi^+\pi^-\pi^+\pi^-$ final states with data for the corresponding quantities in anti pp annihilation as a function of energy. These data show considerable similarity. This similarity leads one to consider a statistical picture for the two reactions based on an incoherent superposition of resonances in the s-channel. Due to the high density of states in the picture developed, the final results are smooth functions of energy in which the phase space for any channel plays the dominant role. Specifically the statistical bootstrap model in which the s-channel resonances decay, sequentially emitting pions one at a time. (JFP)

11824 (IS-T—706) **Electromagnetic form factors of hadrons.** Zidell, V.S. (Ames Lab., Iowa (USA)). Jan 1976. Contract W-7405-eng-82. 225p. Dep. NTIS $7.75.

Thesis.

A vector meson dominance model of the electromagnetic form factors of hadrons is developed which is based on the use of unstable particle propagators. Least-square fits are made to the proton, neutron, pion and kaon form factor data in both the space and time-like regions. A good fit to the low-energy nucleon form factor data is obtained using only rho, ω, and phi dominance, and leads to a determination of the vector meson resonance parameters in good agreement with experiment. The nucleon-vector meson coupling constants obey simple sum rules indicating that there exists no hard core contribution to the form factors within theoretical uncertainties. The prediction for the electromagnetic radii of the proton is in reasonable agreement with recent experiments. The pion and kaon charge form factors as deduced from the nucleon form factors assuming vector meson universality are compared to the data. The pion form factor agrees with the data in both the space and time-like regions. The pion charge radius is in agreement with the recent Dubna result, but the isovector P-wave pion-pion phase shift calculated from the theory disagrees with experiment. A possible contribution to the form factors from a heavy rho meson is also evaluated. (auth)

11825 (ORO—3992-243) **Radiative decay of the J(psi) and other vector mesons in SU(4).** Bohm, A.; Hossain, M.; Kagali, B.A.; Moylan, P.; Teese, R.B.; Valanju, P.M. (Texas Univ., Austin (USA). Center for Particle Theory). Dec 1975. Contract AT(40-1)-3992. 8p. Dep. NTIS $3.50.

The known radiative decay rates of the "old" vector mesons are used to determine the suppression factor for the spectrum generating SU(4) group. From the suppression factor the decay rate for J(psi) yields chi(2.75) + γ and for the radiative decays of other vector mesons. (auth)

11826 (ORO—3992-244) **Neutrino pair bremsstrahlung including neutral current effects.** Dicus, D.A.; Kolb, E.W.; Schramm, D.N.; Tubbs, D.L. (Texas Univ., Austin (USA). Center for Particle Theory). Jan 1976. Contract AT(40-1)-3992. 22p. Dep. NTIS $4.00.

In regions of extreme degeneracy the only process for neutrino pair production which is not suppressed is neutrino bremsstrahlung by a degenerate electron gas interacting with the nuclear Coulomb fields. This process is calculated in a general weak interaction model which includes neutral currents. A static Coulomb potential is assumed and both weak and strong screening are considered. In the limit of extreme degeneracy an analytic approximation for the energy loss rate is given. It is found that neutral currents change the energy loss rate only slightly; for example, in the Weinberg—Salam model the rate is about 1.3 times the rate in the V-A theory. The type of screening does not change the rate by more than a factor of two. (auth)

11827 **Resonances decaying to a photon and a J (psi) particle.** Babcock, J.; Rosner, J.L. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). *Phys. Rev., D;* **12**: No. 9, 2761-2764(1 Nov 1975).

If L = 1 orbital excitations $^3P_{2,1,0}$ of the J(psi) particle exist (assuming it to be a $^3S_1$ quark—antiquark state), the decays $^3P_{2,1}$ yields J(psi) + γ, J(psi) yields $(\text{lepton})^+ + (\text{lepton})^-$ are predicted to yield $W(^3P_2,\theta)$ is proportional to 1 + (0.4 to 0.6)$\cos^2\theta$ and $W(^3P_1,\theta)$ is proportional to $\sin^2\theta$. Here W (θ) is the distribution in angle θ between the photon and either lepton in the J(psi) rest frame. The decay $^3P_0$ yields J(psi) + γ [which must have $W(^3P_0,\theta) \sim = 1 + \cos^2\theta$] is predicted to be suppressed. (AIP)

11828 **Fraction of K^- in the e^+e^- annihilation at 4.15 GeV: The charm and color scheme.** Machacek, M.; Tomozawa, Y.; Yun, S.K. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48104). *Phys. Rev., D;* **12**: No. 9, 2925-2927(1 Nov 1975).

A model based on the SU(4) x SU(3)′ group is proposed. The 4.15-GeV bump in the e^+e^- reaction is associated with a sum of the closely spaced color excited resonances, in order to explain the recently observed K fraction. (AIP)

11829 **Model-independent study of light-cone current commutators.** Gautam, S.R.; Dicus, D.A. (Center for Particle Theory, University of Texas, Austin, Texas 78712). *Phys. Rev., D;* **12**: No. 10, 3310-3314(15 Nov 1975).

An attempt is made to extract information on the nature of light-cone current commutators (LCC) in a model-independent manner. Using simple assumptions on the validity of the Deser—Gilbert—Sudarshan (DGS) representation for the structure functions of deep-inelastic scattering and using the Bjorken—Johnson—Low theorem, we show that in principle the LCC may be constructed if one knows the experimental electron—proton scattering data. On the other hand, the scaling behavior of the structure functions is utilized to study the consistency of a vanishing value for various LCC under mild assumptions on the behavior of the DGS spectral moments. (AIP)

11830 **Photoproduction of J (psi) particles and rising photon—nucleon cross sections.** Young, B.; Lassila, K.E. (Iowa State University, Ames, Iowa 50010). *Phys. Rev., D;* **12**: No. 11, 3424-3430(1 Dec 1975).

The existence of vector mesons with masses above 3 GeV suggests study of their contributions to the Compton sum rule. The Compton sum rule is used to place upper limits on photoproduction cross sections for such recently discovered and yet to be found J/sup p/ = 1^- particles. We are led to the result that the total proton photoabsorption cross section and forward Compton-scattering cross section will rise in the range of energies available for photon experiments at the Fermilab accelerator. Discussion is given on the implications of such a rising photon—proton cross section for vector-meson dominance (VMD), the quark model, generalized VMD, and the new duality, and for scaling breaking. (AIP)

11831 **Quark model of pion photoproduction from protons by polarized photons in the resonance region.** Berger, S.B.; Feld, B.T. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., D;* **12**: No. 11, 3488-3500(1 Dec 1975).

Measurements on the photoproduction of pions from protons by polarized photons are compared with predictions of the conventional quark model in the photon energy range 0.8—1.6 GeV. The experimental data, from an MIT—SLAC collaboration, are for the 90°(in the center-of-mass system) production cross section of positive and neutral pions, both along and normal to the direction of polarization of the incident photons. The computations include s-channel excitation of all observed resonances of mass up to 2 GeV, but neglect nonresonant background effects. Resonances are assigned to the 56-plet representations of SU(6) x O(3); all baryonic states are assumed to be appropriate combinations of three quarks, interacting in an harmonic-oscillator potential. Good qualitative agreement is achieved by appropriate choice of the parameter corresponding to the strength of the potential. A greatly improved fit results from the assignment of the S/sub M/(1535) level to the spin-3/2 octet of the 70-plet, first excited baryon supermultiplet. However, attempts at mixing between corresponding levels of the spin-1/2 and spin-3/2 states of this supermultiplet fail to improve the fit. We interpret this as indicating appreciable mixing of the levels concerned with corresponding states of higher supermultiplets of SU(6). (AIP)

11832 **Angular distribution of particles from transversely polarized e^+e^- colliding beams.** Tsai, Y.S. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **12**: No. 11, 3533-3538(1 Dec 1975).

The effects of transversely polarized electron and positron beams in e^+e^- colliding-beam experiments are discussed. (AIP)

11833 Separation of psi yields $\pi^+\pi^-\gamma$ from psi yields $\pi^+\pi^-\pi^0$. Cahn, R.N. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510 and University of Washington, Seattle, Washington 98195). *Phys. Rev., D;* **12**: No. 11, 3556-3558(1 Dec 1975).

Angular distributions provide a means for determining the frequency of the decay psi yields $\pi^+\pi^-\gamma$, which is generally indistinguishable from psi yields $\pi^+\pi^-\pi^0$ on the basis of the neutral missing mass alone. Radiative decays such as psi yields $\pi^+\pi^-\gamma$ might be expected to be significant on the basis of vector dominance or as a consequence of charm or color models for the psi. (AIP)

11834 Upper bound on charmed quarks in nucleons from the cross section for psi(3100) photoproduction. Goldman, T. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **12**: No. 11, 3669-3672(1 Dec 1975).

A Drell—Yan—type calculation of psi(3100) photoproduction based on the recent data from SPEAR gives a surprisingly large cross section. If the results of the photoproduction experiment at Fermilab are similar to naive vector-meson-dominance expectations, a stringent upper bound on charmed quarks in nucleons is obtained. A consequence for νW_2 at high ω is also noted. (AIP)

11835 Electromagnetic mass splittings of mesons in the charmed-quark model. Lichtenberg, D.B. (Physics Department, Indiana University, Bloomington, Indiana 47401). *Phys. Rev., D;* **12**: No. 11, 3760-3761(1 Dec 1975).

Assuming that the electromagnetic mass splitting of pseudoscalar and vector mesons results from intrinsic quark mass differences plus Coulomb and magnetic interactions, we derive inequalities among the meson masses, including the masses of charmed mesons. (AIP)

11836 Gauge theory with calculable neutron-proton-quark mass difference. Wilkinson, D. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). *Phys. Rev., D;* **12**: No. 12, 3897-3906(15 Dec 1975).

A gauge theory of weak and electromagnetic interactions is presented, in which the neutron-proton-quark mass difference is finite and calculable. The model is a generalization to include strange particles of an SU(2)/subL/ x SU(2)/subR/ x U(1) model suggested by Weinberg; neutral strangeness-changing processes are suppressed using the Glashow-Iliopoulos-Maiani mechanism, which introduces a fourth "charmed" quark P', in addition to the usual P, N, λ. Universality of semileptonic and leptonic weak interactions can easily, though not naturally, be achieved, and the model has the interesting prediction that the effective hadronic neutral current is purely vector. By imposing an additional discrete symmetry, a solution is obtained in which weak universality is natural, and the neutron-quark and proton-quark masses vanish in zero order. (AIP)

11837 Interpretation of elastic electron-deuteron scattering at large momentum transfer. Woloshyn, R.M. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). *Phys. Rev. Lett.;* **36**: No. 4, 220-222(26 Jan 1976).

The meson-exchange-current contribution to the deuteron electromagnetic form factors is interpreted from a quark-interchange point of view. Introducing nucleon structure suggested by the quark model, the calculation of Chemtob, Moniz, and Rho is shown to be in qualitative agreement with recent experimental data. (AIP)

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 11826, 11836, 11857, 11866

11838 (ORO—3992-249) SU(3) symmetry in leptonic decays of pseudoscalar mesons. Bohm, A.; Igarashi, M.; Werle, J. (Texas Univ., Austin (USA). Center for Particle Theory). Feb 1976. Contract AT(40-1)-3992. 8p. (CONF-760118—4). Dep. NTIS $3.50.

From Symposium on mathematical physics; Mexico City, Mexico (5 Jan 1976).

A short report of the present status of SU(3) symmetry in leptonic decays of pseudoscalar mesons is given including some new results. All the more involved calculations are omitted. It is found that this model works quite well in the case of leptonic decays of pseudoscalar mesons. (JFP)

11839 Theoretical interpretation of recent neutral current results. Adler, S.L. (Inst. for Advanced Study, Princeton, NJ). pp 297-327 of In Theories and experiments in high-energy physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

See CONF-750110—P1.

Work on the structure of the weak neutral current is described covering the V, A and S, P, T cases. (JFP)

11840 Vector-meson dominance calculations for the anti ν bar anomaly and dimuon production. Barger, V.; Weiler, T.; Phillips, R.J.N. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). *Phys. Rev., D;* **12**: No. 9, 2628-2631(1 Nov 1975).

We test quantitatively the hypothesis that the Fermilab anomaly in inclusive anti νN yields μ^+X distributions comes from charm production via intermediate vector (V) and axial-vector (A) charmed mesons. Theoretical predictions from this mechanism are integrated over the experimental ν and anti ν spectra, including a scaling background calculated from the parton model. This mechanism can approximately account for the high-y anti νN data with an effective charm production threshold W/sub th/ = 4 GeV and F*N total cross sections of order 10 mb. Better agreement is secured with a higher threshold W/sub th/ = 6 GeV and higher charmed meson—nucleon cross sections. Unsuppressed weak current couplings to charmed D* mesons could enhance the vector-meson-dominance effect. The v and p distributions of the fast μ^- in the dimuon events are consistent with this F* vector dominance contribution. (AIP)

11841 Dimuon production associated with a scalar intermediate boson carrying dileptonic quantum number. Adler, S.L.; Healy, J.B.; Karliner, I.; Lieberman, J.; Ng, Y.J.; Tsao, H. (The Institute for Advanced Study, Princeton, New Jersey 08540). *Phys. Rev., D;* **12**: No. 9, 2639-2643(1 Nov 1975).

We calculate the production cross section and kinematic distributions for dimuons arising from the production of a heavy scalar intermediate boson carrying dileptonic quantum number. The low hadron recoil energy and low effective recoiling invariant masses found in this process exclude it as a candidate for the dimuon events recently observed in experiments at the Fermi National Accelerator Laboratory. (AIP)

11842 Application of current-algebra techniques to soft-pion production by the weak neutral current: V, A cases. Adler, S.L. (The Institute for Advanced Study, Princeton, New Jersey 08540). *Phys. Rev., D;* **12**: No. 9, 2644-2665(1 Nov 1975).

We apply current-algebra techniques to study the constraints imposed on neutral-current-induced soft-pion production, using as input existing bounds on neutrino-proton elastic scattering and existing data on neutral-current-induced deep-inelastic scattering. In the case of a purely isoscalar weak neutral current, a simple soft-pion argument relates the cross section for threshold (in pion—nucleon invariant mass) weak pion production directly to the cross section for neutrino—proton elastic scattering. Hence, a bound on the latter cross section implies a bound on the former. A previous model for weak pion production in the (3,3) resonance region is extended to include low-energy theorem constraints. Numerical work using the extended model shows that a threshold peak in preliminary data on $\nu + n$ yields $\nu + p + \pi^-$ would have implied a threshold cross section much larger than can be obtained with any neutral current formed solely from members of the usual V, A nonets. We analyze recent results for neutral-current-induced soft-pion production under the simplifying assumption of a purely isoscalar V, A neutral current. We find in this case that the magnitude of the observations exceeds the theoretical maximum by more than a factor of 2 unless the assumed isoscalar current either contains a vector part with an anomalously larger gyromagnetic ratio or involves the ninth (SU_3 singlet) axial-vector current. A vector part with a large g value leads to characteristic modifications in the pion--nucleon invariant-mass spectrum for M(πN) less than or equals to 1.4 GeV. Two other qualitative predictions of isoscalar V, A structures are presented. (AIP)

11843 CP violation in charmed-particle decays. Pais, A.; Treiman, S.B. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., D;* **12**: No. 9, 2744-2750(1 Nov 1975).

The discovery of hadrons bearing new quantum numbers ("charm," collectively) would open up new possibilities to pursue the issue of CP violation. The matter of CP signatures for charm-changing processes is discussed in general, model-independent terms save for the assumption that $\Delta C/\Delta Q = 1$ in semileptonic channels. We note certain qualitative differences in the analysis, as compared to charm-conserving reactions. We then raise the issue of indirect effects of CP violation in charm-changing interactions on the neutral K-meson system. In particular, an example is discussed in which CP symmetry breakdown is located in the charm-changing interactions and in which the present CP evidence for charm-conserving decays is qualitatively accommodated. The operational distinctions between this mechanism and another interesting possibility, the presence of a "second" superweak interaction (one with abs. value of $\Delta C = 2$), turn out to be delicately linked to CP tests for exclusive decay processes. (AIP)

11844 Weak-interaction models with new quarks and right-handed currents. Wilczek, F.A.; Zee, A.; Kingsley, R.L.; Treiman, S.B. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510 and Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). *Phys. Rev., D;* **12**: No. 9, 2768-2780(1 Nov 1975).

We discuss various weak-interaction issues for a general class of models within the SU(2) x U(1) gauge-theory framework, with special emphasis on the effects of right-handed charged currents and of quarks bearing new quantum numbers. In particular we consider the restrictions on model building which are imposed by the small K/sub L/—K/sub S/ mass difference and by the $\Delta I = 1/2$ rule, and we classify various possibilities for neutral current interactions and, in the case of heavy mesons with new quantum numbers, various possibilities for mixing effects analogous to K/sub L/—K/sub S/ mixing. (AIP)

11845 Application of current-algebra techniques to soft-pion production by the weak neutral current: S, P, T case. Adler, S.L.; Colglazier, E.W. Jr.; Healy, J.B.; Karliner, I.; Lieberman, J.; Ng, Y.J.; Tsao, H. (The Institute for Advanced Study, Princeton, New Jersey 08540). *Phys. Rev., D;* **12**: No. 11, 3501-3521(1 Dec 1975).

We develop the cross-section formulas needed to correlate information on neutral currents obtained from deep-inelastic neutrino scattering, neutrino—proton elastic scattering, and neutral-current—induced soft-pion production, in the case of neutral currents with S, P, T spatial structure. (The necessary S, P, T current renormalization constants were estimated by us in a previous paper.) The pion-emission amplitude is obtained by current-algebra soft-pion techniques, with the effects of (3, 3)-resonance—excitation taken into account to leading nonvanishing order in the static approximation. We analyze recently reported Brookhaven National Laboratory results for neutral-current—induced soft-pion production under the simplifying assumption of a purely isoscalar S, P, T neutral current, while simultaneously imposing existing bounds on neutrino—proton elastic scattering and fitting existing data on neutral-current—induced deep-inelastic scattering. If all S, P, T renormalization constants are given their central quark-model values, the elastic-scattering and deep-inelastic restrictions constrain the pion-production cross section to be too low compared with experiment; if apparently reasonable deviations of the parameters from the quark-model values are permitted, satisfactory fits to all data are obtained with S, T, with P, T or with S, P, T mixtures. An isovector tensor or pseudoscalar neutral current is found to lead to a strong (3,3) peak in πN invariant-mass plots, but an isovector scalar neutral current can be present without producing a visible (3,3) peak, even when ratios of the various πN charge states produced by the neutral current are appreciably changed from the values which they have in the isoscalar-current case. Constructive T interference with S (or S and P) in $\nu + N$ yields $\nu + N + \pi$ and observation of unequal neutrino- and antineutrino-induced neutral-current cross sections are also indicated. (AIP)

11846 Application of current algebra to soft-pion production induced by the weak neutral current: Second-class V, A case. Adler, S.L.; Dashen, R.F.; Healy, J.B.; Karliner, I.; Lieberman, J.; Ng, Y.J.; Tsao, H. (Institute for Advanced Study, Princeton, New Jersey 08540). *Phys. Rev., D;* **12**: No. 11, 3522-3532(1 Dec 1975).

We apply current-algebra techniques to study neutrino—proton elastic scattering and neutral-current—induced soft-pion production in the case of second-class vector and axial-vector currents. (Such currents are CP-violating if the final and incident neutrinos are identical, but can be CP-conserving if the final and incident neutrinos are different particles.) The second-class currents are constructed phenomenologically from meson fields and the usual first-class V, A quark currents. The matrix elements of the second-class currents between one-nucleon states are estimated by inserting a complete set of intermediate states and saturating the sum with one-nucleon states. In this way the second-class matrix elements are expressed in terms of the experimentally measured renormalization constant of the first-class V, A currents and the pion—nucleon coupling constants. Using standard soft-pion techniques, we analyze recently reported Brookhaven National Laboratory results for neutral-current—induced soft-pion production under the simplifying assumption of a purely isoscalar second-class V, A neutral current. We find in this case that a second-class V—A current is consistent with the reported results. Some qualitative features of second-class neutral currents are equal cross sections for νp and nu-barp elastic scattering, with only the axial-vector current contributing, and very small νp and nu-barp elastic cross sections at energies of order 50 MeV, which are relevant for possible neutrino experiments of the Los Alamos Meson Physics Facility. (AIP)

11847 Heavy neutral lepton as a source of dimuons in high-energy neutrino scattering. Chang, L.N.; Derman, E.; Ng, J.N. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). *Phys. Rev., D;* **12**: No. 11, 3539-3549(1 Dec 1975).

We consider here the possibility that the recently observed oppositely charged muon pairs produced in high-energy neutrino scattering at the Fermi National Accelerator Laboratory originated from the production of a neutral heavy lepton which then decayed into the dimuon pair and a neutrino. Using V - A coupling, we have calculated the total cross section for such heavy-lepton production as well as various measurable distributions for the dimuon pairs and for the recoil hadronic mass. Currently available data are displayed together with the prediction of this model. (AIP)

11848 Polarized electron—nucleus scattering and parity-violating neutral current interactions. Feinberg, G. (Physics Department, Columbia University, New York, New York 10027). *Phys. Rev., D;* **12**: No. 11, 3575-3582(1 Dec 1975).

The polarization asymmetry in the scattering of polarized electrons from nuclei coming from the interference between electromagnetic interactions and parity-violating neutral current interactions is discussed. It is shown how measurements of this asymmetry in various elastic and inelastic electron—nucleus scatterings can be used to determine specific spin and isospin terms in the hadronic neutral current. A specially interesting case would be a measurement in a 0^+ yields 0^- excitation, in which the asymmetry is 100 times larger than usual, because the electromagnetic matrix element involves two-photon exchange. (AIP)

11849 Nonleptonic weak decay and the Melosh transformation. Machacek, M.; Tomozawa, Y. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48104). *Phys. Rev., D;* **12**: No. 11, 3711-3729(1 Dec 1975).

The PCAC (partially conserved axial-vector current) hypothesis and the Melosh transformation are used with the soft-pion and infinite-momentum techniques to obtain expressions for the nonleptonic weak decay of amplitudes of the SU(6)/sub W/ 56, L = 0 baryons. The following results are obtained: (1) Modified Lee—Sugawara relations are exact for both the parity-violating and parity-conserving amplitudes. (2) Two additional sum rules involving Ω^- decay amplitudes are derived. (3) If the parity-violating part of the weak decay Hamiltonian transforms only as an SU(6)/sub W/ 35, then $A(\Sigma^+/\text{sub } +/) = 0$ automatically. (4) Terms arising from the Melosh transformation are necessary to bring the decay width for Ω^- yields $\Xi\pi$ into agreement with experiment. (5) All known amplitudes are fitted to within 10%. (AIP)

11850 Vector anomaly and the magnetic and quadrupole moments of the W boson. DeRaad, L.L. Jr.; Milton, K.A.; Tsai, W. (Department of Physics, University of California, Los Angeles, California 90024). *Phys. Rev., D;* **12**: No. 12, 3972-3977(15 Dec 1975).

The requirement that no vector anomaly be present in the electromagnetic form factors of the W boson leads to superconvergence relations involving the corresponding moments. A consistent solution of these relations can be obtained by assuming that only the sidewise magnetic form factor is once-subtracted. The resulting static quantities, however, differ slightly from those determined by the n-dimensional calculation method. This discrepancy is traced to the fact that the latter results do not satisfy the above-mentioned superconvergence relations. (AIP)

11851 Contributions of vector-meson dominance to charmed-meson production in inelastic neutrino and antineutrino interactions. Einhorn, M.B.; Lee, B.W. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **13**: No. 1, 43-49(1 Jan 1976).

The contribution to neutrino-hadron interaction due F^* dominance of the weak vector current is discussed, and quantitative estimates of the x and y distributions for the deep-inelastic cross section at various energies are given. Other contributions, such as the nonresonant continuum and axial-vector terms, have been qualitatively discussed as well. Results are compared with experimental data on single-muon and dimuon production. The diffractive, "elastic" F^* production cross section is also calculated. (AIP)

11852 Why color fails to show in electroproduction and neutrino scattering experiments. Pati, J.C.; Salam, A. (International Centre for Theoretical Physics, Trieste, Italy). *Phys. Rev. Lett.;* **36**: No. 1, 11-14(5 Jan 1976).

It is shown that the suppression of color-brightening effects in leptoproduction is a general property of a class of spontaneously broken color-gauge theories, based on integer-charge quarks. (AIP)

STRONG INTERACTIONS, GENERAL

REFER ALSO TO CITATION(S) 11881, 11889

11853 M.I.T. Bag Model. Johnson, K. (Massachusetts Inst. of Tech., Cambridge). *Acta Phys. Pol., Ser. B;* **B6**: No. 6, 865-892(1975).

The M.I.T. bag model for hadron structure is reviewed. (auth)

11854 Suppression factors in charmed-particle production. Barger, V.; Phillips, R.J.N. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). *Phys. Rev., D;* **12**: No. 9, 2623-2627(1 Nov 1975).

Quantitative estimates are presented for the production of particles with nonzero charm number, based on the close dynamical similarity with associated production of strange particles, and using the idea that symmetry breaking comes mostly through trajectory displacements. We find that cross sections may be realized at the level of 1 nb for two-body reactions and 60 nb for inclusive reactions in the triple-Regge region. Crucial elements in the calculations are the negative intercepts of the charmed Regge trajectories, and kinematic suppression through the t/sub min/ cutoff. (AIP)

11855 Behavior of the multiplicity with large perpendicular momentum transferred to the leading proton as predicted by multiple quark scattering. Kanofsky, A.S. (Department of Physics, Lehigh University, Bethlehem, Pennsylvania 18015 and Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., D;* **12**: No. 9, 2632-2638(1 Nov 1975).

The previous calculation used to explain the rise in multiplicity with increasing p/sub perpendicular/ given to the leading proton has been extended to include higher order quark—quark scattering terms. It is found that another abrupt rise in the multiplicity can be expected at p/sub perpendicular/ ~ 1.5 GeV/c, where third-order inelastic scattering terms begin to dominate over second-order terms. (AIP)

11856 Chiral invariance in a bag theory. Chodos, A.; Thorn, C.B. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., D;* **12**: No. 9, 2733-2743(1 Nov 1975).

We study phenomena that involve surface fluctuations of a bag by introducing unconfined π-vector and σ fields which interact with the bag only at the surface. The resulting theory is chirally symmetric. We find exact classical solutions to the equations of motion, which have the "hedgehog" property that π-vector(x) = g(r) r-circumflex. In addition, we study other classical solutions perturbatively, and estimate the values of the Δ width and of F/sub π/ predicted by our model. There are no free parameters except the bag constant B, which sets the over-all scale. (AIP)

11857 Hadron mass relations in a charmed quark model with broken SU(8) symmetry. Hendry, A.W.; Lichtenberg, D.B. (Physics Department, Indiana University, Bloomington, Indiana 47401). *Phys. Rev., D;* **12**: No. 9, 2756-2760(1 Nov 1975).

It is assumed that charmed hadrons exist and, together with the usual hadrons, can be classified in representations of SU(8). Hadron masses are assumed to arise from quark masses plus two-body interactions between quarks. Mass relations among the hadrons are obtained. It is estimated that charmed vector mesons have masses about 2 GeV and that charmed baryons have masses between 2.2 and 5 GeV. (AIP)

11858 Comment on charmonium bound-state calculations using potentials. Goldman, T.; Yankielowicz, S. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **12**: No. 9, 2910-2913(1 Nov 1975).

We show that using the Dirac equation to calculate quark bound states can give rise to significantly different eigenspectra than those obtained by using the same potential in the Schrodinger equation, even when $\langle v^2/c^2 \rangle$ is small. The origin of this effect is identified and discussed. (AIP)

11859 Dual resonance model incorporating two different parent Regge trajectories in the same channel. Frampton, P.H.; Rabl, V. (Department of Physics, Syracuse University, Syracuse, New York 13210). *Phys. Rev., D;* **12**: No. 10, 3214-3220(15 Nov 1975).

A four-particle dual model is constructed with two different Regge trajectories in both the s and t channels. The amplitude is crossing-symmetric, has residues that are polynomial of correct order, and has full Regge behavior. In a certain limit it becomes the Euler B function. The multiparticle generalization of the present model will be relevant to construction of hadron models with realistic mass spectra. (AIP)

11860 Analysis of particle production at large transverse momentum. Blankenbecler, R.; Brodsky, S.J.; Gunion, J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **12**: No. 11, 3469-3487(1 Dec 1975).

An analysis of large-transverse-momentum data is carried out using local exponents which characterize the dependence of the cross sections on p/sub T/ and ϵ = (missing mass)^2/s. The results of this effective-power analysis allow any model to be critically compared to the data in a simple but meaningful way. Selected models are examined. A survey of the features of the constituent interchange model (CIM) is given for inclusive scattering, and some special features for electromagnetic processes are discussed. The CIM can explain, in a simple way, not only the behavior of the local exponents but also their specific values for each particle type using the quark-counting rules. Quasielastic peaks in the ϵ distribution are observed for the difference between particle and antiparticle production (p - anti p, K^+ - K^-) which are consistent with expectations. Further crucial tests of the CIM are discussed. (AIP)

11861 Relativistic treatment of the quark-confinement potential. Gunion, J.F.; Li, L.F. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). *Phys. Rev., D;* **12**: No. 11, 3583-3588(1 Dec 1975).

We discuss the spectrum resulting from a relativistic treatment of a linear confinement potential. We employ Klein—Gordon and Dirac wave equations, and regard the linear potential as a Lorentz scalar. (AIP)

11862 Color-symmetry breaking and the baryon spectrum. II. Capps, R.H. (Purdue University, West Lafayette, Indiana 47907 and Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **12**: No. 11, 3606-3612(1 Dec 1975).

Recently the author proposed that the forces between quarks of two of the colors in the colored-quark model are of shorter range than forces involving quarks of the third color, and showed that if this color-symmetry breaking mechanism is strong, the favored baryon SU(6) representations and parities are 56^+ and 70^-, in agreement with experimental indications. In this paper it is shown that this prediction also results if the symmetry breaking is small, in which case the sign of the symmetry breaking is irrelevant. The author discusses a possible experimental way to test the validity of the mechanism and measure the approximate size of the symmetry breaking. A useful list of orthonormal quark-model wave functions of specific energies and symmetries is given. (AIP)

11863 Constituent theory of large-mass production. Sachrajda, C.T.; Blankenbecler, R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **12**: No. 11, 3624-3637(1 Dec 1975).

It is argued that the study of the production of a pair of particles with large invariant mass can provide information on the dynamics of hadronic constituents in a similar way to the study of large-transverse momentum reactions. A general framework for the analysis and interpretation of these reactions is developed in terms of hadron-irreducible subprocesses and the constituent-interchange model. Counting rules are developed that predict the energy and mass dependence of the cross section. In particular, the production of a massive lepton pair or hadron pair in reactions with photon or hadron beams is discussed. A particularly interesting process that is discussed involves the production of a massive hadron pair in electron—positron annihilation. Its importance in measuring properties of generalized structure functions is emphasized. (AIP)

11864 Multiparticle distributions in a fixed range of rapidity. Chen, M. (Physics Department, University of Michigan, Ann Arbor, Michigan 48104). *Phys. Rev., D;* **12**: No. 11, 3708-3710(1 Dec 1975).

A new set of multiparticle distributions is proposed as a simple and useful tool to investigate correlations and scaling properties. These distributions from the reaction p + p yields π^{+-} + anything at 100 GeV are presented and discussed. (AIP)

11865 Supersymmetry of hadron multiplets. Hwa, R.C.; Lam, C.S. (Institute of Theoretical Science and Department of Physics, University of Oregon, Eugene, Oregon 97403). *Phys. Rev., D;* **12**: No. 11, 3730-3737(1 Dec 1975).

The supersymmetry algebra of Wess and Zumino has been generalized to incorporate explicitly the baryon-number operator. Constraints on the algebraic structure due to the finite dimensionality of its representations have been determined. In the rest frame where the supersymmetry generator has only two components, it is shown that an irreducible representation cannot have more than three adjacent baryon numbers. The octet representations in the (B,J_3) space for various SU(3) states are shown to accommodate most of the prominent hadrons. The product represen-

tation of two octets has been reduced to an irreducible octet component, and the consequences on the coupling constants have been determined. The implication on the couplings among the physical hadrons is discussed. (AIP)

STRONG INTERACTIONS, BARYON NO. 0

REFER ALSO TO CITATION(S) 11823, 11835, 11886

11866 (ANL/HEP/PR—75-71) **Instability of collective strong-interaction phenomena in hadron production as a possible origin of the weak and electromagnetic interactions.** Arnold, R.C. (Argonne National Lab., Ill. (USA)). Dec 1975. Contract W-31-109-Eng-38. 21p. Dep. NTIS $3.50.

A systematic calculus of long-range Regge cut effects in multiparticle production is constructed in the form of an infrared-divergent stochastic field theory. Total cross sections and two-body overlap integrals in such a theory may depend very sensitively upon internal quantum-numbers of incident particles, resulting in a strong symmetry breaking at ultra-high energies. Such symmetry violations will influence low energy processes through dispersion relations, and a bootstrap of weak interactions becomes possible. A rough analytic estimate of the scale of thresholds for such effects yields a BCS-type gap equation, which expresses the scale of weak and electromagnetic couplings in terms of purely strong-interaction parameters. (auth)

11867 (LBL—4276) **New spectroscopy.** Trilling, G.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-ENG-48. 86p. (CONF-750754—1). Dep. NTIS $6.00.

From Summer Institute on Particle Physics; Stanford, California, United States of America *USA* (21 Jul 1975).

Review lectures are presented on the properties and decay of psi(3105) and psi(3695). (JFP)

11868 **Transport and hydrodynamic aspects of multiparticle production.** Cooper, F. (Yeshiva Univ., New York); Sharp, D.H. pp 419-441 of In Theories and experiments in high-energy physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1975).

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

See CONF-750110—P1.

It is noted that one can pass directly from quantum field theory to a hydrodynamic description. It is found that when pions are produced in a coherent quantum state, the hydrodynamics properties of the pion field are those of an ideal fluid. It is also verified, for pion production by a classical source, that the hydrodynamic fluid velocity is equal to the particle velocity and that one can introduce a formal entropy. These results are applied to study the effect of source geometry on the predictions of the Landau model. (JFP)

11869 **Angular distributions in the decay psi′ yields psi$\pi\pi$.** Cahn, R.N. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **12**: No. 11, 3559-3563(1 Dec 1975).

A general analysis of the decay amplitudes for psi′ yields psi$\pi\pi$ is presented. Angular distributions are calculated for psi′ yields psi$\pi^+\pi^-$ yields $\mu^+\mu^-\pi^+\pi^-$ in terms of partial-wave amplitudes diagonal in orbital and spin angular momentum. The determination of the partial-wave amplitudes for psi′ yields psi$\pi\pi$ may yield the difference between s-wave and d-wave π—π phase shifts in the I = 0 channel if there is sufficient π—π d-wave present to produce measurable interference. The angular distributions for decays of the form psi yields VPP follow, mutatis mutandis, although VP interactions may prevent the determination of the PP phase shifts. Determination of the partial-wave amplitudes will test the validity of chiral-symmetry models for the psi′yieldspsi$\pi\pi$ decay. (AIP)

STRONG INTERACTIONS, BARYON NO. 1

REFER ALSO TO CITATION(S) 11711, 11834, 11854, 11877

11870 (TID—26946) **Study of the reaction K^-n yields $\pi^-\pi^-\Sigma^+$ using a newly developed isobar model with unitarity.** Capps, C.D. (Florida State Univ., Tallahassee (USA)). 1975. 86p. Dep. NTIS $5.00.

Thesis.

An isobar model utilizing some (all of the T matrix unitarity equations containing 3 yields 3 amplitudes are ignored) of the constraints imposed by unitarity is developed. This model is then used to analyze the reaction K^-n yields $\pi^-\pi^-\Sigma^+$ in the energy region 1.62 to 1.73 GeV. Branching fractions for the decay of formation channel resonances into the excited baryon states $\Lambda(1405)\pi$, $\Lambda(1520)$, and $\Sigma(1385)\pi$ are obtained. (auth)

11871 **Absorption weakening in production of higher-mass states.** Williams, P.K. (Department of Physics, Florida State University, Tallahassee, Florida 32306). *Phys. Rev., D;* **12**: No. 11, 3572-3574(1 Dec 1975).

The rather precipitous weakening of absorption observed in πN yields $\pi\pi N$ for increasing masses of the produced dipion system is explained within the context of the absorption model by combining a Born-term form factor of increasing steepness with absorption of decreasing range. (AIP)

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

REFER ALSO TO CITATION(S) 11864, 11923

11872 **The reaction n+pyieldsd+γ and the isospin structure of the strangeness: conserving nonleptonic weak Hamiltonian.** Perez, M.A. (The Rockefeller University, New York, New York 10021). *Ann. Phys. (N.Y.);* **94**: No. 2, 374-390(Oct 1975).

The circular polarization P/sub gamma/ and angular asymmetry α of the photons emitted in the reaction n+pyieldsd+γ are computed in a covariant formalism within the framework of a composite-particle theory of the deuteron. The most important magnetic and electric dipole transition amplitudes in this radiative capture process are determined through a low-energy theorem. It is found that some of the proposed models for the strangeness-conserving nonleptonic weak Hamiltonian give variations on the ratio α/P/sub gamma/ of one or two orders of magnitude. (AIP)

11873 **Regge model for the reaction pp yields π^+d.** Shtokhamer, R.; Lichtenberg, D.B.; Heinz, R.M. (Physics Department, Indiana University, Bloomington, Indiana 47401). *Phys. Rev., D;* **12**: No. 9, 2666-2669(1 Nov 1975).

A calculation is made of the differential cross section and proton polarization for the reaction pp yields π^+d by using a Regge-pole model with the exchange of the N/sub α/ and N/sub γ/ baryon trajectories. The adjustable parameters of the model are varied to obtain a best fit to the cross-section data at incident momenta above 7 GeV/c. The polarization is predicted to have the characteristic feature of vanishing at t = -0.2 and t = -1.2 $(GeV/c)^2$. (AIP)

11874 **Pion inclusive momentum distribution at 90° in a hydrodynamical model.** Chiu, C.B; Wang, K. (Center for Particle Theory, Department of Physics, University of Texas, Austin, Texas 78712). *Phys. Rev., D;* **12**: No. 9, 2725-2732(1 Nov 1975).

We show that pion inclusive momentum distributions in pp collisions at 90° up to Fermilab and CERN-ISR energies can be accounted for by a hydrodynamical model which has frame-independence symmetry and incorporates the evaporation phenomena. Within our solution, during its space—time development, the matter system possesses only a local thermal equilibrium but not a global equilibrium. The proper time interval needed to achieve this equilibrium comes out to be comparable (with c = 1) to the longitudinal dimension estimated previously based on considerations of quantum statistical fluctuation. (AIP)

11875 **Evaluation of proton—proton elastic scattering with quark hard cores using Glauber and Monte Carlo methods.** Klenk, K.F. (Lehigh Univ., Bethlehem, PA); Kanofsky, A.S. *J. Comput. Phys.;* **19**: No. 4, 353-375(Dec 1975).

It is shown how Monte Carlo methods can be used to evaluate multidimensional integrals that occur in Glauber scattering theory. A detailed discussion of the various Monte Carlo methods is given. The methods are used to obtain the proton-proton elastic scattering differential cross section, where the proton is composed of three quarks with hard cores. It is found that including a quark hard core has no effect on the differential cross section for a fixed rms quark distance. (auth)

11876 **Absorptive corrections to the pion-exchange Deck amplitude.** Berger, E.L.; Irving, A.C. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., D;* **12**: No. 11, 3444-3447(1 Dec 1975).

Consequences of absorbing the pion-exchange amplitude in Deck models are investigated. We make quantitative estimates of the largest corrections to be reasonably expected from an approach to absorption which has been successful in two-body processes. We conclude that the major features of the low-mass enhancement (e.g., spin—parity content, mass, and angular distributions) obtained from the model are not altered by absorption. (AIP)

11877 **Absorptive effects in exclusive diffraction dissociation.** Berger, E.L.; Pirila, P. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., D;* **12**: No. 11, 3448-3468(1 Dec 1975).

We report a detailed investigation of absorptive corrections in Good—Walker and Deck-type models for production of three-body final states in diffraction dissociation processes. Beginning with an input elastic diffractive amplitude which is central in impact parameter, the model generates naturally a peripheral structure for inelastic diffraction. For pp yields ($n\pi^+$) p and np yields ($p\pi^-$) p, at small excitation mass, absorptive effects create significant dip structure in the production momentum transfer distribution $d\sigma/dtdM$ near $t \cong -0.3$ $(GeV/c)^2$, in agreement with data from Fermilab and the CERN-ISR. Similar behavior is predicted for πp yields $A_1 p$ and Kp yields Qp, but at larger abs. values of t. Distributions in other kinematic variables are much less affected by absorption. We provide a decomposition of the total $d\sigma/dtdM$ into partial cross sections for the various angular momentum and helicity states which comprise the low-mass diffractive enhancement. The s-wave amplitude is dominant in both absorbed and unabsorbed models. A pronounced mass-slope correlation is present both in the total $d\sigma/dtdM$ and in the s-wave part alone. (AIP)

11878 **Implications of the energy dependence of a new nucleon—nucleon potential.** Lomon, E.L. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., D;* **12**: No. 11, 3758-3759(1 Dec 1975).

The energy dependence of the core of a new potential formulated by Lacombe, Loiseau, Richard, and Vinh Mau is shown to be replaceable by an energy-independent boundary condition. Furthermore, the radius at which the boundary condition is applied is very close to that of the Feshbach—Lomon interaction, 0.7 F. Outside the core the new potential has a strong basis in theory. It is recommended that further exploration be done with theoretical potentials outside of a boundary-condition-model core. (AIP)

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

11879 **Comment on "Group theory of the spontaneously broken gauge symmetries".** Elias, V.; Eliezer, S.; Swift, A.R. (Univ. of Massachusetts, Amherst). *Phys. Rev., D;* **12**: No. 10, 3356(15 Nov 1975).

A systematic examination was previously made of the pattern of symmetry breaking in the general rotation group O(n) and unitary group SU(n). It is pointed out that in a couple of respects the discussion of SU(n) in this work is incomplete. (JFP)

GENERAL

11880 **Dihedral symmetry and charge conjugation.** Okubo, S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Phys. Rev., D;* **12**: No. 12, 3835-3837(15 Dec 1975).

The charge conjugation C and the parity P are assumed to generate a finite group without assuming any a priori commutation or anticommutation relation. The group then generated is the dihedral group D/subn/ (n being even) which has two-dimensional irreducible representations. This implies that we could have, in principle, elementary particles with parity and charge-conjugation doublet structure. (AIP)

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 11843, 11844, 11845, 11846, 11848, 11849

APPLICATIONS TO STRONG INTERACTIONS

REFER ALSO TO CITATION(S) 11862

11881 **SU(4) σ model.** Schechter, J.; Singer, M. (Physics Department, Syracuse University, Syracuse, New York 13210). *Phys. Rev., D;* **12**: No. 9, 2781-2790(1 Nov 1975).

The mass spectrum of pseudoscalar and scalar mesons is discussed in a general linear SU(4) σ model. We study the way in which the spectrum is influenced by the symmetry of the vacuum and by terms which are the analogs of quark mass terms and quark interaction terms. It is found that a paracharmonium-like state can be naturally accommodated if the charmed "quark mass" is much larger than the others. Other possibilities are also investigated. (AIP)

FIELD THEORY

REFER ALSO TO CITATION(S) 11669, 11820, 11904, 11907

11882 (ANL/HEP/PR—76-04) **Collective enhancement of inclusive cross sections at large transverse momentum in stochastic-field multiparticle theory.** Arnold, R.C. (Argonne National Lab., Ill. (USA)). Jan 1976. Contract W-31-109-Eng-38. Dep. NTIS $3.50.

A stochastic-field calculus, previously discussed in connection with Regge intercepts and instability questions, is applied to inclusive cross sections, and is shown to predict a growth with energy of large-P/perpendicular/ to inclusives. (auth)

11883 (CNRS-CPT—74-P-639, pp 21-28) **Some considerations on nonrenormalizable interactions.** Parisi, G. (Columbia Univ., New York). 1975.

From Colloquium on recent progress in Lagrangian field theory and applications; Marseille, France (24 Jun 1974).

In Recent progress in Lagrangian field theory and applications.

A particular class of nonrenormalizable interactions is studied in the infinite cutoff limit. Arguments are presented which suggest that the theory is finite after the introduction of a finite number of counter terms. The Green functions are not C/sup infinity/ in the coupling constant at the origin. The same results are obtained using three different techniques: infinite resummation of Feynmann graphs in perturbation theory, analogies with second order phase transitions, the use of the renormalization group equation to define the theory. (auth)

11884 (ORO—3992-246) **Renormalization of a distorted gauge: invariant theory.** Hsu, J.P.; Underwood, J.A. (Texas Univ., Austin (USA). Center for Particle Theory). Feb 1976. 26p. Dep. NTIS $4.00.

A new type of renormalizable theory involving massive Yang-Mills fields whose mass is generated by an intrinsic breakdown of the usual local gauge symmetry is considered. However, the Lagrangian has a distorted gauge symmetry which leads to the Ward-Takahashi (W-T) identities. Also, the theory is independent of the gauge parameter xi. An explicit renormalization at the oneloop level is completely carried out by exhibiting counter terms, defining the physical parameters and computing all renormalization constants to check the W-T identities. (auth)

11885 **Collective phenomena in quantum field theory.** Jackiw, R. (Massachusetts Inst. of Tech., Cambridge). *Acta Phys. Pol., Ser. B;* **B6**: No. 6, 919-943(1975).

The discussion of collective phenomena in quantum field theory covers the quantum action, quantum meaning of static and time-dependent classical fields, and prospects for the theory. (JFP)

11886 **Spin-1 vector boson structure of free spin-1/2 quantum field.** Garbaczewski, P. (Univ., Warsaw). *Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.;* **23**: No. 10, 1113-1117(1975).

Construction of a Fock representation of the CAR algebra in a given Fock representation of the CCR algebra is extended to include physically admissible quantum fields: an example of a free spin-1/2 quantum field constructed from a spin-1 vector boson quantum field is considered. (auth)

11887 **Semiclassical bound states in an asymptotically free theory.** Dashen, R.F.; Hasslacher, B.; Neveu, A. (Inst. for Advanced Study, Princeton, NJ). *Phys. Rev., D;* **12**: No. 8, 2443-2458(15 Oct 1975).

A semiclassical calculation of the particle spectrum in the Gross—Neveu model was carried out. It is a two-dimensional model with N species of fermions interacting through a symmetrical scalar-scalar interaction and is renormalizable, asymptotically free, and exhibits spontaneous symmetry breaking. A rich spectrum of particles is found which can be interpreted as fermion-antifermion bound states and multifermion bound states. These states fall into supermultiplets whose origin one does not completely understand. The binding mechanism is a vacuum-polarization effect rather than the direct interaction between particles. A general method for handling fermions in semiclassical calculations is developed. (auth)

11888 **Lorentz-covariant quantization of nonlinear waves.** Klein, A.; Krejs, F. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). *Phys. Rev., D;* **12**: No. 10, 3112-3125(15 Nov 1975).

The quantum theory of a real scalar field in one space dimension with quartic coupling is studied as an example of a field theory possessing exact classical solutions representing extended distributions of energy and momentum. It is shown how formal

canonical quantization can be implemented in practice to obtain self-consistent, Lorentz-covariant descriptions of restricted portions of Hilbert space. This is done by deriving dynamical and kinematical sum rules from the equations of motion and commutation relations, respectively. These sum rules are shown to have a variational basis, which guarantees the consistency of the approach. Overall, we derive Lorentz-covariant generalizations of results found previously by Goldstone and Jackiw by using the same approach, as well as some new results. (AIP)

11889 Quantum mechanics of extended objects in relativistic field theory. Creutz, M. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., D;* **12**: No. 10, 3126-3144(15 Nov 1975).

We study canonical quantization of certain solutions of nonlinear classical field theories known as extended objects. These solutions are characterized by an energy density confined in a finite region of space for all time. We formulate a quantum theory in terms of the normal modes of oscillation about a static solution and the couplings among these modes. A Feynman diagram prescription is given for calculating Green's functions of the fields in the presence of an extended object. We discuss the extension of the formalism to solutions exhibiting a steady rotation in some internal-symmetry space. Problems that may arise in applying the formalism to bag models for quark confinement are mentioned. (AIP)

11890 Comments on vacuum polarizations of magnetic monopoles. Yueh, W.R. (Department of Physics, Columbia University, New York, New York 10027). *Phys. Rev., D;* **12**: No. 10, 3221-3224(15 Nov 1975).

We calculate the electric vacuum polarizations induced by the action of a static monopole charge and find out that there are no induced vacuum currents at all to all orders of the external field and to all orders of the radiative corrections. We also argue that the super-strong Coulomb-type potential screens itself into a short-range one so that there is no magnetic charge renormalization. (AIP)

11891 Scalar bound states and dynamical symmetry breaking. Lemmon, J.; Mahanthappa, K.T. (Department of Physics, University of Colorado, Boulder, Colorado 80302). *Phys. Rev., D;* **12**: No. 10, 3230-3236(15 Nov 1975).

The possibility of a model with a massive fermion, axial-vector and scalar mesons, and a massless vector meson originating as a dynamical consequence of a chiral U(1) x U(1) gauge-invariant model with a massless fermion and vector and axial-vector mesons is explored. A recent approach due to Cornwall which makes use of an effective Lagrangian combined with the Callan—Symanzik equations, and its extension, are used with an assumption similar to that of the Baker—Johnson finite quantum electrodynamics. The physical quartic scalar coupling constant and the ratios of physical masses of axial-vector and scalar mesons with respect to that of fermions are expressed in terms of the vector and axial-vector gauge coupling constants. (AIP)

11892 Fermion—fermion scattering in a Yang—Mills theory at high energy: Sixth-order perturbation theory. McCoy, B.M.; Wu, T.T. (Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11794). *Phys. Rev., D;* **12**: No. 10, 3257-3271(15 Nov 1975).

We study the high-energy behavior of the elastic scattering of two isospin-1/2 fermions interacting through the Yang—Mills field. The Higgs mechanism is invoked so that there is no infrared divergence. In the sixth order, the amplitude for isovector exchange is found to behave as s $\ln^5 s$ multiplied by a function of t, while the amplitude for isoscalar exchange behaves as s ln s multiplied by another function of t. These results are qualitatively different from the answers previously given in the literature. In particular, there is no contribution to the leading terms from large transverse momentum transfers; this is the reason why we obtain one less factor of ln s in sixth order. (AIP)

11893 Goldstone realization of γ_5-gauge symmetry in quantum electrodynamics. Narayanaswamy, P. (Center for Particle Theory, University of Texas, Austin, Texas 78712). *Phys. Rev., D;* **12**: No. 10, 3296-3301(15 Nov 1975).

The relevance of the Goldstone theorem to quantum electrodynamics with zero-bare-mass electrons is re-examined. It is shown that solutions exist corresponding to the Goldstone realization of γ_5-gauge symmetry. The result will also be valid for fermion quarks interacting strongly with massless vector gluons. (AIP)

11894 Elementary particles in a curved space. IV. Massless particles. Fronsdal, C. (Department of Physics, University of California, Los Angeles, California 90024). *Phys. Rev., D;* **12**: No. 12, 3819-3830(15 Dec 1975).

If physics is stable with respect to a class of perturbation of the spacetime metric, including that of "small" constant four-dimensional curvature, then it may be shown that (1) left-handed and right-handed neutrinos are distinguished by a superselection rule; (2) magnetic monopoles cannot exist; (3) the conformal symmetry associated with the field equations for massless particles with spin 0, 1/2, and 1 is spontaneously broken: except in the case of neutrinos with fixed chirality. (AIP)

11895 Some remarks about unquantized non-Abelian gauge fields. Wu, T.T.; Yang, C.N. (Gordon McKay Laboratory, Harvard University, Cambridge, Massachusetts 02138). *Phys. Rev., D;* **12**: No. 12, 3843-3844(15 Dec 1975).

For unquantized non-Abelian gauge fields, remarks are made on the question of whether the field strengths determine the gauge field, on the dual transformations, and on complex gauge fields. (AIP)

11896 Concept of nonintegrable phase factors and global formulation of gauge fields. Wu, T.T.; Yang, C.N. (Gordon McKay Laboratory, Harvard University, Cambridge, Massachusetts 02138). *Phys. Rev., D;* **12**: No. 12, 3845-3857(15 Dec 1975).

Through an examination of the Bohm-Aharonov experiment an intrinsic and complete description of electromagnetism in a space-time region is formulated in terms of a nonintegrable phase factor. This concept, in its global ramifications, is studied through an examination of Dirac's magnetic monopole field. Generalizations to non-Abelian groups are carried out, and result in identification with the mathematical concept of connections on principal fiber bundles. (AIP)

11897 Quantum theory of Cerenkov radiation in a uniaxial crystal. Kong, J.A. (Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., D;* **12**: No. 12, 3858-3860(15 Dec 1975).

The quantum theory of Cerenkov radiation caused by a Dirac particle moving along the optical axis in a uniaxial crystal is developed in the context of phenomenological quantum electrodynamics. Using time-dependent perturbation theory, the transition probability per unit time and the total energy of the radiated extraordinary photons are determined. (AIP)

11898 Dimensional regularization and mass singularities. Marciano, W.J. (Department of Physics, Rockefeller University, New York, New York 10021). *Phys. Rev., D;* **12**: No. 12, 3861-3871(15 Dec 1975).

How the continuous-dimension method can be employed to simultaneously regularize infrared photonic divergences and electron mass singularities (i.e., terms which diverge in the limit m/sube/ yields 0) is demonstrated. Using this technique, a photon mass need not be introduced and the electron mass can be set equal to zero from the start, thereby simplifying radiative-corrections calculations. Transition rates obtained in this approach are functions of the regularizing parameter n (the dimension of space-time). To determine which of these rates are finite in the limit n yields 4, the theorem on the cancellation of mass singularities is used. Even for transition rates which contain residual mass singularities, this method is useful for extracting leading logarithmic corrections. The formalism of this approach is illustrated for the decay of a charged intermediate vector boson. (AIP)

11899 Klein-Gordon equation with discontinuous mass: An instructive nonlinear classical field theory. Kazama, Y.; Goldhaber, A.S. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). *Phys. Rev., D;* **12**: No. 12, 3872-3879(15 Dec 1975).

The Klein-Gordon equation with a discontinuous field-dependent mass term provides an example of a simple nonlinear classical field theory. This theory is studied to determine if it exhibits a behavior hypothesized in a recently proposed picture of multimeson production. As expected, it turns out that (with a small additional decay term in the equation) the space-time average of the field strength generated by a δ-function source can be made insensitive to the source strength, once it exceeds a certain threshold. When two space-time-separated δ-function sources are present, their independence (or dependence) in producing slow mesons is determined by the ratio of decay time to source separation. If the mass in the region of low field strength is imaginary, then there are stable sourceless "kink" solutions in one space dimension. (AIP)

11900 Quantization of the localized solutions in two-dimensional field theories of massive fermions. Lee, S.Y.; Gavrielides, A. (Department of Physics, Purdue University, Lafayette, Indiana 47907). *Phys. Rev., D;* **12**: No. 12, 3880-3886(15 Dec 1975).

Using the semiclassical functional method developed by Dashen, Hasslacher, and Neveu, the classical localized solutions for the bound states of massive fermions in two-dimensional field theories are quantized. The mass spectra of the bound states are then obtained. For the massive Gross-Neveu model, the mass spectrum agrees with what has been found by Dashen et al. for the massless Gross-Neveu model where fermions acquire mass through dynamical symmetry breaking. For a theory of massive fermions with scalar as well as pseudoscalar Fermi interactions, the mass spectrum is found to be very similar to that for the doublet in the sine-Gordon equation. In fact, under certain conditions they become identical. (AIP)

11901 Domain structure of a Reggeon field theory with three couplings. Geer, K.A.; Pinsky, S.S. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). *Phys. Rev., D;* **12**: No. 12, 3996-4000(15 Dec 1975).

The high-energy behavior of a Reggeon field theory with a three-Reggeon coupling and two four-Reggeon couplings is considered. Using the renormalization-group equations which are calculated in lowest order by Bardeen et al. for this model, a study is made of the way the couplings evolve to the fixed points in the high-energy limit. It is found that there are three fixed points (plus a fourth at infinity) to which the couplings can evolve. The space of couplings divides into four domains, two of which are two-dimensional and two of which are three-dimensional. The couplings in one of the three-dimensional domains are found to evolve to infinity and the couplings in the other three domains are found to evolve to the fixed-point couplings. The boundaries of these domains and some characteristic evolution curves are shown. The implications of the domain structure of the model are discussed. (AIP)

11902 Bilinear quantum field theories and their coherent states. DeFacio, B.; Hammer, C.L. (Ames Laboratory-ERDA and Department of Physics, Iowa State University, Ames, Iowa 50010). *J. Math. Phys. (N.Y.);* **17**: No. 2, 267-281(Feb 1976).

The quantization method developed by Hammer and Tucker, which is based upon a set of equations of motion and their conserved currents rather than a canonical formalism, is extended to interacting systems. The operators of the theory are bilinear and are essentially self-adjoint on a dense domain which is spanned by a suitably chosen subset of the coherent states. Both proper and improper gauge transformations of the second kind are discussed. For the proper case, the connection is given between these transformations and coherent states, which are discussed in detail. One interesting result is that a "smeared" Fock space can be constructed for a system where the particles have the same average quantum numbers. For the improper case, the gauge transformation of the second kind is related to the purely absolutely continuous measure. The formalism is applied to two examples. One is a Dirac field minimally coupled to a massive vector field, and the other is Klauder's ultralocal models. (AIP)

11903 On the duality condition for quantum fields. Bisognano, J.J.; Wichmann, E.H. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *J. Math. Phys. (N.Y.);* **17**: No. 3, 303-321(Mar 1976).

A general quantum field theory is considered in which the fields are assumed to be operator-valued tempered distributions. The system of fields may include any number of boson fields and fermion fields. A theorem which relates certain complex Lorentz transformations to the TCP transformation is stated and proved. With reference to this theorem, duality conditions are considered, and it is shown that such conditions hold under various physically reasonable assumptions about the fields. Extensions of the algebras of field operators are discussed with reference to the duality conditions. Local internal symmetries are discussed, and it is shown that these commute with the Poincare group and with the TCP transformation. (AIP)

SCATTERING THEORY

REFER ALSO TO CITATION(S) 11892, 11902

11904 (COO—2482-4) **Physical optics far field inverse scattering in the time domain.** Bleistein, N. (Denver Univ., Colo. (USA)). 1976. Contract AT(11-1)-2482. 31p. Dep. NTIS $4.00.

The physical optics far field inverse scattering (POFFIS) identity relates the phase and range normalized far field back scattering amplitude to the spatial Fourier transform of the characteristic function of the scattering obstacle. The characteristic function is equal to unity in the region occupied by the obstacle and zero elsewhere. The original identity was derived by Bojarski for impulsive point sources. The result is extended to sources of arbitrary time dependence. One obtains an alternative form of Bojarski's POFFIS identity. One also derives a POFFIS identity in the time domain. Numerically synthesized checks on the method are provided. (auth)

11905 (ORO—4856-44) **Heuristic method for determining outgoing waves in many-body wave functions.** Redish, E.F.; Tandy, P.C.; L'Huillier, M. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Dec 1975. 11p. Dep. NTIS $3.50.

A new and simple method is proposed for determining the kinds of outgoing waves present in a given many-body wave function. Whether any particular wave function contains "hidden" rearrangement components can be determined. 1 figure (auth)

11906 Absolutely continuous subspace of a self-adjoint operator in Hilbert space. Gustafson, K. (Univ. of Colorado, Boulder); Johnson, G. *Helv. Phys. Acta;* **47**: No. 2, 163-166(1974).

The absolutely continuous subspace H/sub ac/(T), an object of interest in the scattering theory of quantum mechanics and in other applications involving the spectra analysis of a self-adjoint operator T, is characterized exactly as the closure, in the given Hilbert space H, of the subspace of vectors phi satisfying the resolvent growth condition on individual vectors: parallel R/sub z/(T)phi parallel = O(y/sup -1/)/), y = Imz yields O . (auth)

11907 Inclusive cross sections and angular distributions in Reggeon field theory. Abarbanel, H.D.I.; Bartels, J.; Bronzan, J.B.; Sidhu, D. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **12**: No. 9, 2798-2814(1 Nov 1975).

We use the Reggeon field-theory rules for inclusive reactions to study those processes in the triple-Regge region. We first show that at asymptotic energies the dominant Reggeon graphs have a single Pomeron connected to external fast particles. We construct the sum of these dominant graphs by obtaining the infrared forms of the Pomeron propagator and triple-Pomeron vertex. This is done by an expanded set of renormalization-group equations which allow one to determine the separate dependencies on all momenta and energies. As a by-product we obtain the momentum-transfer dependence of dσ/dt in 2 yields 2 processes. The inclusive cross section is discussed in detail as to its dependence on momentum transfer and missing mass, and we verify that there is no violation of s-channel unitarity when Pomerons interact among themselves. We also estimate the energy at which our asymptotic forms start to become valid. (AIP)

11908 Extensions of the derivative dispersion relations for amplitude analyses. Sukhatme, U.; Kane, G.L.; Blankenbecler, R.; Davier, M. (Department of Physics, University of Michigan, Ann Arbor, Michigan 48104). *Phys. Rev., D;* **12**: No. 11, 3431-3440(1 Dec 1975).

It is shown that analyticity properties of scattering amplitudes as expressed by the derivative analyticity relations can be combined with measured cross-section and polarization data to extract the full scattering amplitudes in a simple and practical way. The method should be particularly useful in problems involving a coupled amplitude analysis. The measurement of a complete set of spin parameters, or a phase-shift analysis at only one energy, is sufficient to eliminate ambiguities in the extraction at all other energies. Our procedure is illustrated by considering both simple mathematical examples and real data. (AIP)

11909 Multi-Regge behavior of a certain class of dual resonance models. Frampton, P.H.; Knight, D. (Syracuse Univ., NY). *Lett. Nuovo Cim.;* **15**: No. 4, 125-128(24 Jan 1976).

It is shown that a five-point function with S_5 invariance and which is otherwise theoretically acceptable may nevertheless violate multi-Regge asymptotic behavior. (JFP)

11910 Dependence of the off-energy-shell T matrix on the total three-momentum. Heller, L.; Bohannon, G.E.; Tabakin, F. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev., C;* **13**: No. 2, 742-748(Feb 1976).

The Bakamjian-Thomas form of relativistic potential theory is used to derive a constraint on the off-energy-shell two-body T matrix elements. This is an equation which specifies the dependence of these matrix elements on the total three-momentum. While other formulations lead to different constraints, it is argued that this one is the most convenient. The distinction between this formula and the (irrelevant) notion of Lorentz transforming an off-energy-shell matrix element is discussed. A critical comparison is made with several formulas which have appeared in the literature in connection with the problem of scattering a π meson by a nucleus. (AIP)

11911 On the equality of S operators corresponding to unitarily equivalent Hamiltonians in single channel scattering. Saenz, A.W.; Zachary, W.W. (Naval Research Laboratory, Washington, D.C. 20375). *J. Math. Phys. (N.Y.);* **17**: No. 3, 409-418(Mar 1976).

Some years ago, conditions in order that unitarily equivalent Hamiltonians H and W*HW yield the same S operator were investigated by Ekstein and by Coester and his collaborators in the framework of nonrelativistic time-dependent single-channel quantum scattering theory. This subject has turned out to be of considerable importance for nuclear physics, since it constitutes the foundation of a widely used method for constructing phase-equivalent nucleon—nucleon potentials. In the present paper we derive a rigorous and concise necessary and sufficient condition for a pair of unitarily equivalent Hamiltonians, governing the dynamics of a pair of nonrelativistic particles in the center-of-mass system, to yield the same S operator. Our theory, based on a time-dependent approach, applies to very general types of short-range potentials, with or without hard cores, and to an extensive class of long-range potentials. Our necessary and sufficient condition simplifies when certain strong limits W/sub plus-or-minus/, related to W, are unitary and when W/sub +/=W/sub -/. Requirements sufficient for each of these properties to hold are determined. Various examples of operators W such that H and W*HW have the same S operator are discussed. (AIP)

NUCLEAR PHYSICS

REFER ALSO TO CITATION(S) 10955, 11773

11912 (BNL—50445, pp 61-66) **Search for stable strange nuclei.** Schiffer, J.P. (Argonne National Lab., IL). 1974.

From BeV;nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In Report of the workshop on GeV/nucleon collisions of heavy ions: how and why.

Evidence for the existence of strange stable nuclei is explained. Experiments on neutron capture by collapsed or abnormal nuclei are discussed and some estimates of production of strange nuclei on the lunar surface are presented. 5 figures, 6 tables (SDF)

11913 (GEAP—14073-1) **Cooperative nuclear data and methods development. First annual progress report for fiscal year 1975.** Cowan, C.L. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Aug 1975. Contract AT(04-3)-893. 22p. AT.

The benchmark calculations for the Phase II testing of ENDF/B-IV (evaluated nuclear data file/B, version IV) were carried out and completed in accordance with the Cross-Section Evaluation Working Group (CSEWG) specifications. The benchmark calculations were performed for eight plutonium-fueled assemblies. A comparison of the experimental results indicates some general trends for data adjustment. The recommendations include a lower ^{238}U inelastic cross section between 0.5 and 2.0 MeV, a lower ^{238}U capture cross section, and higher delayed neutron fractions. Spectrum measurements in a uranium assembly carried out at Rensselaer Polytechnic Institute (RPI) indicate a lower inelastic cross section for ^{238}U than recommended by ENDF/B-IV. Testing of the RPI-modified inelastic data has been carried out for several fast reactor benchmark criticals. The Processing Code Subcommittee of the Code Evaluation Working Group met in Washington, D.C., on March 2, 1975, to formulate the work plans and milestones for testing data processing codes. Two initial problems were selected. GE participation is based on TDOWN calculations starting with the generalized cross section file output from MINX. The burnup of actinides in LMFBRs is being investigated as a potentially important technique for disposal. Recycling of actinides in LMFBRs should produce higher burnups than recycling in thermal reactors because the fission cross sections are relatively more important in a fast flux and is further favored by neutronics and fuel management considerations. To assess recycling in LMFBRs, the actinide isotopes which contribute most to the total actinide hazard have been identified, and a preliminary evaluation of nuclear data needs and availability has been made. Preliminary calculations indicate that actinide recycling in LMFBRs may significantly alleviate the long-term waste disposal problem associated with them. (auth)

11914 (LA—5961) **Electron elastic scattering cross sections from 1 keV to 100 MeV for elements Z = 1 to 100.** Storm, E.; Hancock, J.H. (Los Alamos Scientific Lab., N.Mex. (USA)). Apr 1975. Contract W-7405-Eng-36. 311p. Dep. NTIS $10.75.

Tables of electron elastic scattering differential cross sections of elements (Z = 1 to 100) are given for electron energies in the range of 1 keV to 100 MeV and scattering angles in the range of 1 to 179°. The function describing the asymmetry of a polarized electron beam after the scattering process is also included in the tables. (auth)

11915 (LA-DC—11039) **Nuclear physics studies with fast neutrons: a survey.** Hopkins, J.C. (Los Alamos Scientific Lab., N.Mex. (USA)). Sep 1969. Contract W-7405-ENG-36. 212p. Dep. NTIS $8.75.

A survey of recent nuclear physics experiments with fast neutrons is presented. The survey is limited to those studies involving a neutron, with an energy greater than 0.5 MeV, in the entrance channel. Neutron capture is specifically excluded. The first part gives descriptions of 6 representative fast-neutron experimental techniques or facilities. In the second part, 11 specific fields are identified and reviewed. The fields are: (1) the nucleon-nucleon interaction, (2) total cross sections, (3) fluctuation phenomena, (4) elastic and inelastic scattering, (5) (n,2n) cross sections, (6) (n,charged particle) cross sections, (7) (n,xγ) cross sections, (8) polarization, (9) electromagnetic neutron-nucleus interactions, (10) fission, and (11) high-energy phenomena. The final section contains a few brief comments regarding the directions that fast-neutron physics research may take in the future. (auth)

11916 **Tables of nuclear structure amplitudes for two-nucleon transfer involving light projectiles (A less than or equal to 4).** Glendenning, N.K. (Univ. of California, Berkeley). *At. Data Nucl. Data Tables;* **16**: No. 1, 1-134(Jul 1975).

Tables are presented of values of the nuclear structure amplitudes required for construction of form factors for the reactions (α,d), (^{3}He,p), (^{3}He,n), (t,n), (t,p), and their inverses. (auth)

11917 **Superallowed 0^+ yields 0^+ and isospin-forbidden J/sup π/ yields J/sup π/ Fermi transitions.** Raman, S. (Oak Ridge National Lab., TN); Walkiewicz, T.A.; Behrens, H. *At. Data Nucl. Data Tables;* **16**: No. 5, 451-494(Nov 1975).

Experimental data on Q-values, β end-point energies, half-lives, and branching ratios pertaining to superallowed 0^+ yields 0^+ β-transitions are compiled and evaluated. Out of a total of eighteen Ft values, seven are known to better than 0.3 percent accuracy. The weighted average of all values, Ft = 3088.6 + - 2.1 sec, was employed to determine the effective vector coupling constant G'/sub V/ = (1.4115 +- 0.0005) x 10^{-49} erg cm^3. Experimental data on β-transitions between states of same spin but different isospin are also compiled and evaluated if they yield Fermi matrix elements. Information is obtained on isospin impurities of thirty-three nuclear states ad deduced from β-decay experiments. The isospin impurities are extremely small, the largest being 0.05 percent reported for the ^{64}Ga ground state. The literature survey ended in April 1975. 9 tables, 4 figures. (auth)

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 10529, 12077

11918 (KFK—2231) **Scattering law of polycrystalline and liquid rubidium.** Suck, J.B. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Angewandte Kernphysik). Dec 1975. 89p. (In German). Dep. NTIS (US Sales Only) $5.00.

The scattering law of polycrystalline and liquid rubidium was measured for momentum transfers between 1.0 and 2.5 1/A and for energy transfers up to 16 MeV with a rotating crystal TOF-spectrometer. The energy of the incoming neutrons was 5 MeV. The polycrystal was measured at 123 and 294 K and the liquid at 318 K near its melting point. The data are corrected for background, selfabsorption, and multiple scattering. In the scattering law of the polycrystal at 123 K a peak structure is seen for energy transfers greater than 0, which is damped out in the results of the polycrystal at 294 K and the liquid. The measured scattering laws are compared with several scattering law models. Only the 123 K results give really satisfactory agreement. From the data of the polycrystals the density of states are extracted. For the liquid the 4. moment, some points of the 6. moment, and the relaxation function tau(Q) are determined. (auth)

11919 (LA—5987) **Consistency among differential nuclear data and integral observations: the ALVIN code for data adjustment, for sensitivity calculations, and for identification of inconsistent data.** Harris, D.R.; Reupke, W.A.; Wilson, W.B. (Los Alamos Scientific Lab., N.Mex. (USA)). May 1975. Contract W-7405-Eng-36. 33p. Dep. NTIS $5.00.

Successful nuclear design requires adequate prediction of integral design parameters, and this in turn requires an adequate differential nuclear data base. Data bases that apparently permit reduced biases and design margins have been developed by a) least squares adjustment of differential data or b) trial-and-error selection from alternative evaluated data sets. Criticisms and defenses of such procedures are discussed. Useful data adjustment is related to consistency of the combined differential-integral data set and consistency tests related to least squares adjustment procedures are

described. An approach to data adjustment is suggested that is contingent on consistency analysis. A FORTRAN code ALVIN has been developed to carry out the indicated data consistency and adjustment calculations, and to compute required sensitivities of integral parameters to nuclear data changes. The sensitivity modules of ALVIN are validated by computing with two distinct methods the cross-section sensitivity profile for neutron penetration through a thick iron shield. The data consistency and adjustment modules DAFT2 (for arbitrary variance-covariance data) and DAFT3 (for differential data base of arbitrary size uncorrelated with integral data) are validated by comparing their results for a set of data for three ZPR criticals. 2 figures, 5 tables, 51 references (auth)

11920 (LA—6201-MS) **TIMEX: a time-dependent explicit discrete ordinates program for the solution of multigroup transport equations with delayed neutrons.** Hill, T.R.; Reed, W.H. (Los Alamos Scientific Lab., N.Mex. (USA)). Jan 1976. Contract W-7405-Eng-36. 72p. Dep. NTIS $6.00.

TIMEX solves the time-dependent, one-dimensional multigroup transport equation with delayed neutrons in plane, cylindrical, spherical, and two-angle plane geometries. Both regular and adjoint, inhomogeneous and homogeneous problems subject to vacuum, reflective, periodic, white, albedo or inhomogeneous boundary flux conditions are solved. General anisotropic scattering is allowed and anisotropic inhomogeneous sources are permitted. The discrete ordinates approximation for the angular variable is used with the diamond (central) difference approximation for the angular extrapolation in curved geometries. A linear discontinuous finite element representation for the angular flux in each spatial mesh cell is used. The time variable is differenced by an explicit technique that is unconditionally stable so that arbitrarily large time steps can be taken. Because no iteration is performed the method is exceptionally fast in terms of computing time per time step. Two acceleration methods, exponential extrapolation and rebalance, are utilized to improve the accuracy of the time differencing scheme. Variable dimensioning is used so that any combination of problem parameters leading to a container array less than MAXCOR can be accommodated. The running time for TIMEX is highly problem-dependent, but varies almost linearly with the total number of unknowns and time steps. Provision is made for creation of standard interface output files for angular fluxes and angle-integrated fluxes. Five interface units (use of interface units is optional), five output units, and two system input/output units are required. A large bulk memory is desirable, but may be replaced by disk, drum, or tape storage. 13 tables, 9 figures. (auth)

11921 (ORNL/TM—5224) **Iterative solution of the diffusion and P_1 finite element equations.** Tomlinson, E.T.; Robinson, J.C.; Vondy, D.R. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 97p. Dep. NTIS $6.50.

Thesis. Submitted to the University of Tennessee, Knoxville.

A method for obtaining solutions to the time-independent Boltzmann neutron transport equation on triangular grids with nonorthogonal boundaries and anisotropic scattering is developed. A functional is obtained from the canonical form of the multigroup transport equation. The angular variable is then removed by expanding the functional in spherical harmonics, retaining only the first two moments and limiting the anisotropic scattering to be linear. The finite element method is then implemented by using quadratic Lagrange-type interpolating polynomials to span the spatial domain. The resultant set of coupled linear equations is then solved iteratively. The applicability of convergence acceleration techniques developed for the finite difference method is tested and implemented where appropriate. Finally, a number of numerical experiments are performed to evaluate the performance of the proposed method. The results are compared to results obtained by various established methods. In all cases, agreement is excellent. 16 figures, 7 tables. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

MASS, ABUNDANCE, AND BINDING ENERGY

11922 **Integral relation for the asymptotic normalization of the triton.** Lehman, D.R.; Gibson, B.F. (Department of Physics, The George Washington University, Washington, D.C. 20052). *Phys. Rev., C;* **13**: No. 1, 35-37(Jan 1976).

An integral relation is derived for the asymptotic normalization constant of the neutron—deuteron tail in the triton wave function. The formula resembles integrals employed in obtaining the triton wave function, and it should be particularly useful for calculating the asymptotic normalization of wave functions obtained from local potentials. (AIP)

NUCLEAR REACTIONS AND SCATTERING

11923 **Relativistic three-body calculation of πd scattering.** Woloshyn, R.M.; Moniz, E.J.; Aaron, R. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., C;* **13**: No. 1, 286-298(Jan 1976).

We present a unitary, Lorentz-invariant three-body calculation of pion-deuteron elastic scattering, based upon the idea of quasiparticle-dominated two-body interactions. We make detailed comparisons of these results with those of a conventional fixed-scatterer approach and find that the fixed-nucleon calculation does not adequately reproduce the three-body results; this finding demonstrates the importance of properly treating the three-body kinematics (i.e., of including nucleon recoil and isobar propagation). The multiple scattering expansion converges much more rapidly in the three-body approach than in the fixed-scatterer calculation. Intermediate nucleon-nucleon interactions play an important role, giving contributions to the scattering amplitude of the same order as those given by pion multiple scattering; these effects are especially significant for back-angle scattering. Finally, we compare our results with the available experimental data for the πd total and integrated elastic cross sections and obtain good agreement. Nucleon spin is neglected in all calculations. (AIP)

11924 **Extraction of resonance parameters from nuclear scattering data.** Ahmed, M.U.; Shanley, P.E. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). *Phys. Rev. Lett.;* **36**: No. 1, 25-27(5 Jan 1976).

A procedure is described for extracting the pole position of a resonant amplitude from a knowledge of the phase shift versus energy. Pole positions are determined for the four p-wave resonances in the nucleon-α system with high precision. The use of the pole position to define the mass of unstable nuclear states is discussed. (AIP)

11925 **Pion charge exchange on ^{3}H.** Hess, A.T.; Gibson, B.F. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev., C;* **13**: No. 2, 749-753(Feb 1976).

The reaction $^3H(\pi^+,\pi^0)^3He$ has been examined using separable pion-nucleon t matrices in a formalism which incorporates multiple scattering to all orders. Spin-flip effects are shown to be important. The total cross section has a maximum of about 7 mb in the neighborhood of the (3,3) resonance. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 11926

NUCLEAR REACTIONS AND SCATTERING

11926 (JUL-Conf—16(Vol.1), pp 90) **Experimental study of highly excited states by the (d,^{3}He) reaction on p-shell nuclei.** Didelez, J.P.; Chang, C.C.; Bhowmik, R.; Holmgren, H.D.; Steinberg, R.I.; Wu, J. (Univ. of Maryland, College Park). Jul 1975.

From Conference on highly excited states of nuclei; Julich, F.R. Germany (22 Sep 1975).

In International symposium on highly excited states in nuclei, Juelich, 23—26 September 1975. Volume 1.

11927 (UCRL—50400(Rev.1)(Vol.6)) **Tables and graphs of photon interaction cross sections from 1.0 keV to 100 MeV derived from the LLL Evaluated Nuclear Data Library.** Plechaty, E.F.; Cullen, D.E.; Howerton, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Oct 1975. Contract W-7405-Eng-48. 505p. Dep. NTIS $13.60.

Energy-dependent evaluated photon interaction cross sections and related parameters are presented for the elements H through Cf (Z = 1 to 98). Data are given over the energy range from 1 keV to 100 MeV. The related parameters include form factors and average energy deposits per collision (with and without fluorescence). Fluorescence information is given for all atomic shells that can emit a photon with a kinetic energy of 1 keV or more. In addition, the following macroscopic properties are given: total mean free path and energy deposit per centimeter. This information is derived from the Livermore Evaluated Nuclear Data Library (ENDL) as of Oct. 1975. (auth)

11928 ^{3}H(p,2p)n reaction at 23 MeV under the condition of collinearity of the final state particles in the center-of-mass system. Lambert, J.M.; Treado, P.A.; Allas, R.G.; Beach, L.A.; Bondelid, R.O.; Diener, E.M. (Georgetown University, Washington, D.C. 20007). *Phys. Rev., C;* 13: No. 1, 43-45(Jan 1976).

The ^{3}H(p,2p)n reaction has been investigated under the special kinematic condition that the neutron is at rest in the center of mass. A comparison of experiment and theory is used to examine the significance of the spectral structure observed for such collinearity conditions. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 12073

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 11949, 12069

11929 Simple approximation for multistep amplitudes. Cotanch, S.R.; Vincent, C.M. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). *Phys. Rev. Lett.;* 36: No. 1, 21-25(5 Jan 1976).

A surface approximation to the multistep amplitude for direct reactions is presented. Within this approximation, the distorted-wave Born-approximation series is summed in closed form, and the result is tested by comparing with exact coupled-reaction-channels calculations for ^{17}O(p,d,p)^{17}O and ^{16}O(d,p,d)^{16}O. The approximation gives a good representation of the exact results, especially for the ^{16}O(d,p,d)^{16}O process which is dominated by strong absorption of the deuteron. (AIP)

11930 Pion charge-exchange scattering from light nuclei. Gibbs, W.R.; Gibson, B.F.; Hess, A.T.; Stephenson, G.J. Jr.; Kaufmann, W.B. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev. Lett.;* 36: No. 2, 85-88(12 Jan 1976).

The reactions ^{7}Li(π^{+},π^{0})^{7}Be, ^{10}B(π^{+},π^{0})^{10}C, and ^{12}C(π^{+},π^{0})^{13}N are examined using a full multiple-scattering formalism with a separable form assumed for the pion-nucleon t matrix. Spin-flip contributions are included. It is found that the contributions arising from transitions to nonanalog final states in the case of ^{10}B and ^{7}Li are of the same order of magnitude as pure analog cross sections. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

11931 Mass of ^{8}C. Tribble, R.E.; Kenefick, R.A.; Spross, R.L. (Cyclotron Institute, Texas AandM University, College Station, Texas 77843). *Phys. Rev., C;* 13: No. 1, 50-54(Jan 1976).

A new determination of the mass excess of ^{8}C by the ^{12}C(^{4}He,He)^{8}C reaction has yielded a value of 35.10+-0.04 MeV. The new value is in good agreement with the quadratic isobaric multiplet mass equation prediction. Higher order cubic and quartic mass equation coefficients are found to be small for the A=8 isobaric quintet. (AIP)

RADIOACTIVE DECAY

11932 Beta decay of ^{16}C and ^{17}N. Alburger, D.E.; Wilkinson, D.H. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., C;* 13: No. 2, 835-846(Feb 1976).

The delayed neutron emitters ^{16}C and ^{17}N have been studied in the reaction ^{14}C(^{18}O,^{16}O)^{16}C with 56-MeV ^{18}O ions, and also in the reaction ^{11}B(^{7}Li,2p)^{16}C with 40-MeV ^{7}Li ions. The thermalized neutrons following both reactions yield together a ^{16}C half-life of 0.747+-0.008 sec with the well-known 4.17-sec ^{17}N activity as an accompaniment formed in the ^{14}C(^{18}O,^{17}N)^{15}N and ^{11}B(^{7}Li,p)^{17}N reactions. The neutron spectra in a bare ^{3}He detector contain ^{16}C lines of 0.79+-0.03 MeV and 1.72+-0.05 MeV in addition to ^{17}N peaks. The ^{16}C neutron groups are assigned to the β decay to the known 3.36- and 4.32-MeV 1^{+} states of ^{16}N. A search for γ rays associated with ^{16}C forbidden β decay to the 0^{-}, 3^{-}, and 1^{-} levels of ^{16}N gave upper limits for the respective branching ratios. The logft values for β decay to the 3.36- and 4.32-MeV states, 3.551+-0.012 and 3.83+-0.05, respectively, disagree seriously with preliminary theoretical values of 5.17 and 4.66, respectively, due to Millener. Separate studies were made of ^{17}N decay, formed in the ^{15}N(t,p)^{17} reaction at E/subt/=3.0 MeV. By using an empirical neutron efficiency function, β-ray branches of ^{17}N to the ^{17}O neutron-emitting states at 4.55, 5.38, and 5.94 MeV were found to be in disagreement with two previously reported measurements. γ-ray measurements on ^{17}N with a Ge(Li) detector yielded the following: ratio of β-ray branching intensities B_{871}/B_{3055}=8.6+-0.4; $B_{3841}<7\times10^{-5}$ corresponding to logft >8.5 for this β-ray branch fixing the ^{17}N spin as J/sup pi/=1/2^{-}; energy of ^{17}O second-excited state 3055.2+-0.3 keV; and ground-state γ-ray branch, from the 3055.2-keV level <1.5%. The mirror β decays of the A=17 system are discussed. An incidental result is a half-life of 178.3+-0.4 msec for ^{9}Li formed in the t (^{7}Li,p)^{9}Li reaction with 20—40-MeV ^{7}Li ions. (AIP)

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 11926, 11937, 11938, 11941

11933 (JUL-Conf—16(Vol.1), pp 2) **Search for isovector giant E2 states in ^{12}C and ^{16}O.** Warburton, E.K.; Noe, J.W.; Snover, K.A.; Suffert, M.; Warburton, E.K.; Kuan, H.M. (SUNY, Stony Brook, NY). Jul 1975.

From Conference on highly excited states of nuclei; Julich, F.R. Germany (22 Sep 1975).

In International symposium on highly excited states in nuclei, Juelich, 23—26 September 1975. Volume 1.

11934 Long-lived states at high excitation energies in ^{8}Be and ^{10}B. Ajzenberg-Selove, F.; Maguire, C.F.; Hendrie, D.L.; Scott, D.K.; Mahoney, J. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). *Phys. Rev., C;* 13: No. 1, 46-49(Jan 1976).

A study of highly excited states in ^{8}Be and ^{10}B has been conducted using the ^{9}Be(He,α) and ^{11}B(^{3}He,α) reactions at E(^{3}He) = 49.3 MeV and the Berkeley magnetic spectrometer. We observe three new states in ^{8}Be at E/sub x/ = 22.05, 22.63, and 22.98 MeV (+-0.1 MeV) with Γ/sub c.m./ < 0.3 MeV. In ^{10}B we confirm the previously known states ^{10}B* (10.85, 11.52, 12.56) and report a new state ^{10}B* (13.49) with Γ/sub c.m./ = 0.3 MeV, in addition to two broader states. Comparisons are made with the analog regions in ^{8}Li and ^{10}Be. (AIP)

11935 Investigation of the $(d_{5/2})^{2}$ and $(d_{5/2}s_{1/2})$ two-particle configurations in ^{18}O using the ^{17}O(d,p)^{18}O reaction at 18 MeV. Li, T.K.; Dehnhard, D.; Brown, R.E.; Ellis, P.J. (School of Physics, University of Minnesota, Minneapolis, Minnesota 55455). *Phys. Rev., C;* 13: No. 1, 55-67(Jan 1976).

Differential cross sections of deuteron elastic scattering from ^{17}O and of the ^{17}O(d,p)^{18}O reaction have been measured at a deuteron bombarding energy of 18 MeV for transitions to 12 states in ^{18}O up to an excitation energy of 6.341 MeV. Absolute spectroscopic factors were extracted with the aid of distorted-wave Born-approximation calculations. The results are compared with theoretical calculations and show a distinct preference for a weak-coupling model. Diagonal matrix elements of the effective neutron—neutron interaction were deduced from the data for the $(d_{5/2})_{0^{+}}$,$_{4^{+}}$ and $(d_{5/2}s_{1/2})_{2^{+}}$,$_{3^{+}}$ configurations. A theoretical estimate of the errors involved is in qualitative agreement with the deviations observed between experiment and theory. (AIP)

11936 Gamma decay of the 13.42-MeV state of ^{15}N. Kuan, H.M.; Shirk, D.G. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., C;* 13: No. 2, 883-886(Feb 1976).

The γ decay of the 13.42-MeV state of ^{15}N, studied via the reaction ^{14}C(p,γ)^{15}N using Ge(Li) detectors, is found to be 100% to ^{15}N(g.s.) with Γ/subp/Γ/sub gamma/0/Γ=1.70+-0.5 eV, Γ/sub gamma/0=3.0 + -0.9 eV, and a M2/E1 mixing ratio of 0.00 + -0.04. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 11793, 11926, 11927, 11931, 11932, 11933, 11934, 11935, 11936, 11978

11937 (COO—535-733, pp 2-4) **Study of the ^{9}Be(p,d)^{8}Be reaction at 14.5 MeV.** Zimmerman, W.R. 1 Nov 1975.

In Technical progress report and proposal for continuation of contract.

11938 (COO—535-733, pp 44-45) **Study of the reaction ^{16}O(^{3}He,t)^{16}F.** Cecil, F.E.; Emigh, R.A.; Anderson, R.E.; Peterson, R.J. 1 Nov 1975.

In Technical progress report and proposal for continuation of contract.

11939 (COO—535-733, pp 98-100) **180° electron scattering from ^{14}N.** Ensslin, N.; Bendel, W.L.; Fagg, L.W.; Jones, E.C.; Lindgren, R.A. 1 Nov 1975.

In Technical progress report and proposal for continuation of contract.

11940 (ORNL-TM—5204) **SB3. Experiment on secondary gamma-ray production cross sections averaged over a fast-neutron spectrum for each of 13 different elements plus a stainless steel.** Maerker, R.E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 36p. (ENDF—228). Dep. NTIS $5.00.

The experimental and calculational details for a CSEWG integral data testing shielding experiment are presented. This particular experiment measured the secondary gamma-ray production cross sections averaged over a fast-neutron spectrum for iron, oxygen, sodium, aluminum, copper, titanium, calcium, potassium, silicon, nickel, zinc, barium, sulfur, and a type 321 stainless steel. The gamma-ray production cross sections were binned into 0.5-MeV wide gamma-ray energy intervals. 29 tables, 1 figure (auth)

11941 **^{14}C(d,t)^{13}C reaction-cross-section and analyzing-power measurements at 14 MeV.** Weller, H.R.; Blue, R.A.; Darden, S.E.; Yoh, W.A. (Department of Physics, University of Florida, Gainesville, Florida 32601). *Phys. Rev., C;* **13**: No. 1, 38-42(Jan 1976).

Cross-section and vector-analyzing-power measurments have been performed for the ^{14}C(d,t)^{13}C reaction leading to the ground and first three excited states of ^{13}C. A 14-MeV vector-polarized beam was employed for the measurements. Distorted-wave Born-approximation calculations agree reasonably well with the data. The results suggest a 2p—2h admixture of a ($d_{5/2}^{\ 3}$, sp^{-2})/sub n/ configuration having an intensity of 4% and a ($2s_{1/2}^{\ 2}$, sp^{-2})/sub n/ configuration with an intensity of 3% in the ground state of ^{14}C. (AIP)

11942 **^{8}Be producing reactions in ^{12}C + ^{12}C, ^{16}O + ^{16}O, and ^{28}Si + ^{12}C.** Artz, J.L.; Greenfield, M.B.; Fletcher, N.R. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). *Phys. Rev., C;* **13**: No. 1, 156-163(Jan 1976).

The ^{12}C(^{12}C, ^{8}Be), ^{16}O(^{16}O, ^{8}Be), and ^{28}Si(^{12}C, ^{8}Be) reactions show final state relative populations which are very similar to the corresponding (^{6}Li, d), (^{7}Li, t), (^{12}C, α), and (^{16}O, ^{12}C) reactions on the same target nuclei. Selective population of final states for ^{12}C and ^{28}Si targets is accompanied by rapidly fluctuating excitations for the ^{12}C(^{12}C, ^{8}Be) reactions and much smoother, yet not flat, excitation functions for ^{28}Si(^{12}C, ^{8}Be). Angular distributions are forward peaked. The ^{16}O(^{16}O, ^{8}Be) reaction is not selective, similar to ^{16}O(^{12}C, α). (AIP)

11943 **^{12}C(p,pn)^{11}C cross section at 300 GeV.** Kaufman, S.B.; Weisfield, M.W.; Wilkins, B.D.; Henderson, D.; Steinberg, E.P. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **13**: No. 1, 253-256(Jan 1976).

The absolute cross section for the ^{12}C(p,pn)^{11}C reaction has been measured in the M2 diffracted proton beam of the Fermi National Accelerator Laboratory at an energy of 300 GeV. Proton intensities were measured with a scintillation counter telescope, and the 20.4-min ^{11}C activity induced in 3.2-mm thick plastic scintillator targets was determined both by internal scintillation (β) counting and by annihilation radiation counting with a NaI well crystal. A correction for the formation of ^{11}C by secondary particles was determined by measuring the activity in individual targets in a stack. The corrected value for the ^{12}C(p,pn)^{11}C cross section at 300 GeV is 24.6+-1.6 mb. (AIP)

11944 **"Resonances" in ^{12}C(^{12}C,α)^{20}Ne and ^{12}C(^{12}C,^{8}Be)^{16}O reactions at about 37 MeV.** Eberhard, K.A.; Bernhardt, K.G. (Nuclear Physics Laboratory, University of Washington, Seattle, Washington 98195). *Phys. Rev., C;* **13**: No. 1, 440-443(Jan 1976).

Angular distributions and excitation functions for ^{12}C(^{12}C, α)^{20}Ne and ^{12}C(^{12}C,^{8}Be)^{16}O have been measured around E/sub ^{12}C/(c.m.) =18.5 MeV, where strongly correlated structure for both reactions has been reported. Both ground-state angular distributions are dominated by a single angular momentum; for ^{12}C(^{12}C,)^{20}Ne/sub g.s/ the dominant angular momentum is l=10, while for ^{12}C(^{12}C, ^{8}Be/sub g.s./)^{16}O/sub g.s./ it is l=12. Hauser-Feshbach calculations reproduce the shapes of the angular distributions; the dominant angular momenta are the grazing partial waves in the outgoing channels. (AIP)

11945 **^{12}C(^{16}O,^{12}C)^{16}O* inelastic scattering in the region of the E/sub c.m./=19.7 MeV resonance.** Sperr, P.; Henning, W.; Erskine, J.R. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **13**: No. 1, 447-449(Jan 1976).

Excitation functions and angular distributions have been measured with high resolution for inelastic scattering to the 0^+ 6.050-MeV, 3^- 6.131-MeV, 2^+ 6.919-MeV, and 1^- 7.119-MeV states in ^{16}O near the E/sub c.m./=19.7-MeV resonance in the ^{12}C+^{16}O system. The 0^+ and 2^+ states show no resonant behavior whereas the 3^- state does. These results do not support an explanation for the E/sub c.m./=19.7-MeV resonance which involves an α-particle exchange mechanism. (AIP)

11946 **Measurements of the (π^+,π^0) reaction on light elements in the (3,3)-resonance region.** Shamai, Y.; Alster, J.; Ashery, D.; Cochavi, S.; Moinester, M.A.; Yavin, A.I.; Arthur, E.D.; Drake, D.M. (Department of Physics and Astronomy, Tel-Aviv University, Ramat-Aviv, Israel). *Phys. Rev. Lett.;* **36**: No. 2, 82-85(12 Jan 1976).

The cross sections for the reaction (π^+,π^0) on ^{7}Li, ^{10}B, and ^{12}C were measured over the energy range of 70 to 250 MeV by activation methods. The excitation functions were found to be flat with cross sections of about 2.5 mb for ^{7}Li, 0.4 mb for ^{10}B, and 1.0 mb for ^{12}C. (AIP)

11947 **Excitation functions of pion reactions on ^{14}N, ^{16}O, and ^{19}F through the (3,3) resonance.** Jacob, N.P. Jr.; Markowitz, S.S. (Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). *Phys. Rev., C;* **13**: No. 2, 754-766(Feb 1976).

Cross sections for pion-induced reactions of the form (π,πN) and more complex spallation reactions of the form (π,X) have been measured from 50—550 MeV on the target nuclei ^{14}N, ^{16}O, and ^{19}F using the secondary pion beams at the Lawrence Berkeley Laboratory 184-inch synchrocyclotron and the Clinton P. Anderson Meson Physics Facility. The dominance of the (3,3) free-particle resonance is seen in all excitation functions determined in this work. Relative to the ^{12}C(π/sup plus-or-minus/,πN)^{1}C reactions, the (π/sup plus-or-minus/,πN) reactions on ^{14}N, ^{16}O, and ^{19}F have magnitudes of 0.2, 1, and 0.7, respectively. The cross section ratio R=σ (π^-,π^-n)/σ (π^+,π N) =1.68+-0.18 for ^{14}N at 188+-15 MeV, 1.68+-0.05 for ^{16}O at 188+-9 MeV, and 1.68+-0.03 for ^{19}F at 178+-2 MeV incident pion energy. The results from this work are compared to previous pion work, analogous proton-induced reactions, Monte Carlo intranuclear cascade-evaporation calculations, and to a semiclassical nucleon charge-exchange model which convincingly explains the (π,πN) reaction mechanism in the (3,3) resonance region. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

11948 (IPNO/TH—75-24) **Shape transition in the neutron rich sodium isotopes.** Campi, X.; Flocard, H.; Kerman, A.K.; Koonin, S. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Jun 1975. Contract AT(11-1)-3069. 28p. Dep. NTIS $4.00.

Mass spectrometer measurements of the neutron rich sodium isotopes show a sudden increase at ^{31}Na in the values of the two neutron separation energies. The spherical shell model naturally predicts a sudden decrease at ^{32}Na after the N = 20 shell closure. It is proposed that the explanation for this disagreement lies in the fact that Sodium isotopes in this mass region are strongly deformed due to the filling of negative parity orbitals from the lf/sub $^{7}/_{2}$/ shell. Hartree-Fock calculations are presented in support of this conjecture. (auth)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 11959, 12067

11949 **Intermediate-energy (40 MeV < or ≅ E/sub γ/ < or ≅ 400 MeV) photonuclear interactions.** Gabriel, T.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee, 37830). *Phys. Rev., C;* **13**: No. 1, 240-244(Jan 1976).

Comparisons between theoretical and recent experimental photoproton spectra are presented for 400-MeV bremsstrahlung on carbon, aluminum, copper, and gold. Experiments are suggested which would facilitate further theoretical considerations. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

RADIOACTIVE DECAY

11950 **Decay of ^{38}K.** Fritts, M.J. (Nuclear Physics Laboratory, Department of Physics and Astrophysics, University of Colorado, Boulder, Colorado 80302). *Phys. Rev., C;* 13: No. 1, 331-338(Jan 1976).

^{38}K was produced via the ^{38}Ar(p, n)^{38}K reaction. Measurement of 27 β^+ delayed γ rays associated with the decay of ^{38}K implied 10 new β^+ branches to energy levels in ^{38}Ar. Branching ratios and logft values are calculated for the β^+ branches. Restrictions on spin and parity assignments for the ^{38}Ar levels are given, as well as branching ratios for γ transitions from these levels. The half-life of ^{38}K is determined to be 344 +- 3 msec. (AIP)

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 11950, 11956, 11957

11951 **Excitation of analogs of giant dipole states via the reaction ^{27}Al(n,p)^{27}Mg.** Brady, F.P.; King, N.S.P.; McNaughton, M.W.; Satchler, G.R. (Crocker Nuclear Laboratory and Department of Physics, University of California, Davis, California 95616). *Phys. Rev. Lett.;* 36: No. 1, 15-18(5 Jan 1976).

Analogs of giant-dipole-resonance states have been excited in ^{27}Mg via the ^{27}Al(n,p)^{27}Mg reaction using 56.1-MeV neutrons. This reaction is restricted to $\Delta T=1$ transitions and thus provides a unique way of studying the T/sub greater-than/ components of the giant dipole resonances. A comparison with photonuclear and (p,p') spectra is made in an attempt to separate T/sub greater-than/ from T/sub less-than/ components and E1 from the overlapping E2 isoscalar resonances. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 11927, 11940, 11942, 11951

11952 (COO—2324-5) **Recoil properties of ^{11}C and ^{18}F produced in the interaction of 1- to 11.5-GeV protons with ^{27}Al. Progress report.** (Illinois Univ., Chicago (USA)). [nd]. Contract E(11-1)-2324. 13p. Dep. NTIS $3.50.

This work is a continuation of the recoil study of radioactive products from the proton bombardment of Al. Recoil properties of ^{11}C and ^{18}F are reported for proton energies of 1, 3, 6, and 11.5 GeV. Values of 2W(F+B) are tabulated and plotted. 2 figures, 4 tables (RWR)

11953 (ORNL-TM—5203) **SB2. Experiment on secondary gamma-ray production cross sections arising from thermal-neutron capture in each of 14 different elements plus a stainless steel.** Maerker, R.E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-Eng-26. 36p. (ENDF—227). Dep. NTIS $5.00.

The experimental and calculational details for a CSEWG integral data testing shielding experiment are presented. This particular experiment measured the secondary gamma-ray production cross sections arising from thermal-neutron capture in iron, nitrogen, sodium, aluminum, copper, titanium, calcium, potassium, chlorine, silicon, ickel, zinc, barium, sulfur and a type 321 stainless steel. 1 figure, 30 tables (auth)

11954 (ORNL-TM—5241) **Cross sections for the Al(n,xn) and Al(n,xγ) reaction between 1 and 20 MeV.** Morgan, G.L.; Perey, F.G. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 57p. Dep. NTIS $5.50.

Differential cross sections for the production of secondary neutrons and photons from aluminum have been measured at 127° (lab) for incident neutron energies in the range 1 to 20 MeV. An electron linac was used as a neutron source with a white spectrum. Incident neutron energies were determined using time-of-flight techniques for a source-to-sample distance of 48 m. Secondary spectra were determined by unfolding the pulse-height distributions observed in a NE-213 scintillation counter. The results are compared to the current evaluated data file (ENDF/B-IV, MAT 1193). (auth)

11955 **Thermal neutron cross sections and (n,γ) resonance integrals. I.** Gleason, G. (Oak Ridge Associated Universities, TN). *Radiochem. Radioanal. Lett.;* 23: No. 5-6, 317-323(19 Dec 1975).

By activation in a graphite-moderated ^{252}Cf facility, thermal cross sections and resonance integrals have been measured for 18 nuclides. In general, these determinations have shown only minor differences from published values. A noted exception is the thermal cross section for the ^{81}Br(n,gamma)^{82}Br reaction which was found to be 2.1 +- 0.1 barns (combining the metastable state) which is significantly lower than the values of about 3 barns found in the literature. 2 tables (auth)

11956 **Single proton transfer to $^{29-36}$P states.** Dykoski, W.W.; Dehnhard, D. (John H. Williams Laboratory of Nuclear Physics, University of Minnesota, Minneapolis, Minnesota 55455). *Phys. Rev., C;* 13: No. 1, 80-97(Jan 1976).

Differential cross sections were measured for the (^{3}He,d) reaction on ^{28}Si and ^{30}Si at E/sub ^{3}He/ = 25 MeV by use of an Enge split-pole spectrometer. Up to 19 point angular distributions for transitions to 12 states in ^{29}P below 6.4 MeV excitation energy and to 66 states in ^{30}P below 8.7 MeV were analyzed in the distorted-wave Born approximation. The optical model parameters required for the distorted-wave Born approximation analysis were obtained from elastic ^{3}He scattering data which were taken on ^{28}Si, ^{29}Si, and ^{30}Si. A number of ^{30}P levels were found to have large components of simple two-particle structure, with one particle in the $2s_{1/2}$ shell and the other in either the $2s_{1/2}$, $1d_{3/2}$, $1f_{7/2}$, or $2p_{3/2}$ shell. Specifically, the states at 6092 and 7048 keV were assigned J/sup π/ = 3$^-$, T = 1 and J/sup π/ = 4$^-$, T = 1, respectively, because they were found to carry a significant fraction of the $(2s_{1/2})(1f_{7/2})$ strength. However, the T=0 components of the $(2s_{1/2})$, $(2s_{1/2})(1d_{3/2})_1+$, and $(1d_{3/2})^{-1}(2s_{1/2})^2_{3}+$ configurations were found to be distributed among a large number of states. Spin assignments were made based on shapes of the angular distributions and analog relations to ^{30}Si states. An estimate of the extent to which the $1d_{3/2}$ proton shell is filled in ^{28}Si and ^{30}Si was extracted. (AIP)

11957 **$^{29-30}$Si(^{16}O,^{15}N) proton stripping reaction at 60 MeV.** Dehnhard, D.; Artz, J.L.; Weber, D.J.; Shkolnik, V.; DeVries, R.M. (Williams Laboratory of Nuclear Physics, University of Minnesota, Minneapolis, Minnesota 55455). *Phys. Rev., C;* 13: No. 1, 164-170(Jan 1976).

Differential cross sections of the [(^{16}O,^{15}N) (g.s.)] reaction on ^{29}Si and ^{30}Si were measured at E (^{16}O) =60 MeV at far forward angles. The strongly oscillatory $\Delta L=1$, (2) angular distributions for the $2s_{1/2}$ and $1d_{3/2}$ transitions to ^{30}P and ^{31}P were found to be out of phase. The pure $\Delta L=1$, $2s_{1/2}$ transitions were fitted well by finite range distorted wave Born approximation calculations using the code LOLA. The phase of the structure of the $1d_{3/2}$ transfer angular distributions could not be fitted with the distorted wave Born approximation. Spectroscopic factors were in good agreement with (^{3}He,d) results for $2s_{1/2}$ and $1d_{3/2}$ transitions and a factor of 2 too large for $1d_{3/2}$ transfer. This factor of 2 for the $1d_{3/2}$ transitions is not understood. The mixed j transition to the 2$^+$ state in ^{30}P (1.454 MeV) was found to be consistent with almost exclusive j=3/2 transfer as predicted by shell model calculations. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

11958 (COO—535-733, pp 13-20) **Energy dependence of the normalization factor for the ^{56}Ni(^{3}He,α)^{57}Ni reaction.** Shepard, J.R.; Zimmerman, W.R.; Kraushaar, J.J.; Kaczkowski, P. 1 Nov 1975.

In Technical progress report and proposal for continuation of contract.

11959 (COO—535-733, pp 49-53) **Pickup—stripping contribution to ^{3}He elastic scattering.** Shepard, J.R.; Kunz, P.D.; Kraushaar, J.J. 1 Nov 1975.

In Technical progress report and proposal for continuation of contract.

11960 (COO—535-733, pp 55-60) **Microscopic analysis of alpha—nucleus scattering in the energy range from 20 to 140 MeV.** Ridley, B.W.; Chang, H.H. 1 Nov 1975.

In Technical progress report and proposal for continuation of contract.

11961 (ORNL/TM—5161) **Calculated nucleon spectra at several angles from 192-, 500-, 700-, and 900-MeV carbon-12 on iron-56.** Bertini, H.W.; Santoro, R.T.; Hermann, O.W. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 17p. Dep. NTIS $5.00.

Neutron spectra were calculated as a function of angle between 0 and 110° for ^{12}C on ^{56}Fe at 192, 500, 700, and 900 MeV. Proton spectra were calculated for the same angular range but for only 192-MeV ^{12}C on ^{56}Fe. The most significant property

of these spectra is that there is an appreciable number of neutrons emitted with energies greater than the incident energy per nucleon at all angles investigated. 9 figures. (auth)

11962 Structure of doorway states in the ^{40}Ca + n reaction. Castel, B.; Halderson, D. (Queen's Univ., Kingston, Ontario (Canada). Dept. of Physics); Micklinghoff, M. (Hamburg Univ. (F.R. Germany). 1. Inst. fuer Theoretische Physik); Divadeenam, M. (Brookhaven National Lab., Upton, N.Y. (USA)). *Z. Phys., A;* 274: No. 3, 275-278(1975).

3 figs.; 1 tab.; 20 refs.

A model including 2p—1h and collective states in ^{41}Ca is used to investigate the intermediate structure resonances seen in the n + ^{40}Ca reaction. With potential well parameters determined by a calculation of the bound states it is found that most of the s-wave strength can be accounted for by the inclusion of one main doorway state component. (DE)

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 11965, 12028

ENERGY LEVELS AND TRANSITIONS

11963 Level structure measurements with the (p,α), (^{3}He,d), and (^{3}He,dγ) reactions: Energy levels in ^{51}Mn and ^{53}Mn. Tarara, R.W.; Goss, J.D.; Jolivette, P.L.; Neal, G.F.; Browne, C.P. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). *Phys. Rev., C;* 13: No. 1, 109-117(Jan 1976).

The level structures of ^{51}Mn and ^{53}Mn have been studied using our 100-cm broad range magnetic spectrograph and the ^{54}Fe(p,α)B&51Mn and ^{56}Fe(p,α)^{53}Mn reactions. Precise level energies in ^{51}Mn have been measured up to the region of 4 MeV in excitation. Thirty-four states have been identified in this region of excitation, 10 of which have not previously been reported. The uncertainty in energy of the third excited state at 1488.9 keV has been reduced from 10 keV to 0.8 keV. We confirm the new levels at 2893 and 3049 proposed in a recent ^{50}Cr(p,γ)^{51}Mn experiment, but do not observe levels at 2488, 2660, 2717, and 2808 reported in an earlier ^{50}Cr(p,γ) experiment. Using the ^{56}Fe(p,α)^{53}Mn reaction, we have found 28 previously unreported levels in the region up to 5.1 MeV in excitation. We confirm the existence of four of the five high spin states recently reported in ^{50}Cr(α,pγ)^{53}Mn work at 2563.7, 2693.5, 2697.3, 3425.6, and 3440.5 keV. We were unable to resolve the 3.8-keV doublet at 2694 keV. We do not observe levels at 1940, 2448.1, 2761.0, 2967.3, and 2978.1 keV which have been proposed or observed in previous ^{52}Cr(p,γ) studies. In addition we did not observe the levels reported at 2370 and 3061 keV in previous ^{52}Cr(^{3}He,d)^{53}Mn experiments. Our ^{50}Cr(^{3}He,d)^{53}Mn and ^{52}Cr(^{3}He,dγ) ^{53}Mn measurements do not show these levels. (AIP)

11964 Low-lying levels of ^{57}Mn from the ^{54}Cr(α,p) reaction. Mateja, J.F.; Neal, G.F.; Goss, J.D.; Chagnon, P.R.; Browne, C.P. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). *Phys. Rev., C;* 13: No. 1, 118-123(Jan 1976).

Proton energy spectra from the ^{54}Cr(α,p)^{57}Mn reaction at 15, 21, and 24 MeV and at several angles have been measured with the 100-cm broad-range spectrograph. Both NaI(Tl) and Ge(Li) detectors have been used to study γ rays, in coincidence with protons in a particle detector, from the same reaction. From the spectrograph measurements, the ground-state Q value is found to be -4308+-8 keV. Excited levels have been found at 84.1+-1.0, 851.1+-1.0, 1059.2+-2.0, 1073.8+-2.0, 1227.1+-1.0, 1376.5+-1.3, 2188.2+-1.1, and 2234.3+-1.7 keV. Ten γ-ray transitions have been observed. From particle-γ coincidence and angular-correlation measurements the spins of some levels can be limited as follows: 84 keV, 3/2-7/2; 851 keV, 3/2 or 5/2; 1059 keV, 1/2-5/2. Probable spin assignments for these three levels suggested on the basis of cross-section and relative transition-strength considerations are (7/2), (3/2), and (1/2), respectively. Other tentative spin assignments, and the comparison of ^{57}Mn with other odd Mn isotopes, are discussed. (AIP)

11965 Coupled quadrupole-octupole excitations in ^{44}Ca and the decay of ^{44}K, ^{44}Sc/subm/ and ^{44}Sc/subg/ . Coleman, G.; Meyer, R.A. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., C;* 13: No. 2, 847-858(Feb 1976).

The decay of ^{44}K, ^{44}Sc/subg/, and ^{44}Sc/subm/ to levels of ^{44}Ca have been studied. For decay of ^{44}K, approximately 125 γ rays have been observed using singlet, Compton-suppression, and γ-γ-coincidence Ge(Li) spectroscopy. The decay data, used in conjunction with recent reaction spectroscopy data, have led to the identification of 35 levels in ^{44}Ca that are populated in β decay. The levels below 4500 keV are discussed within the framework of multiple vibrations. The levels at (J/sup pi/ in parenthesis) 3661.53 (1$^-$), 3676.07 (2$^-$), 3711.80 (4$^-$), 3913.8 (5$^-$), and 4358.42 keV (3$^-$) are suggested as the two phonon quadrupole-octupole pentad. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 11793, 11927, 11940, 11953, 11955, 11963, 11964, 11988

11966 (ORNL-TM—5098) Cr(n,xγ) reaction cross section for incident neutron energies between 0.2 and 20.0 MeV. Morgan, G.L.; Newman, E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 51p. (ENDF—222). Dep. NTIS $5.50.

Differential cross sections for the neutron-induced gamma-ray production from natural chromium have been measured for incident neutron energies between 0.2 and 20.0 MeV. The Oak Ridge Linear Accelerator (ORELA) was used to provide the neutrons and a NaI spectrometer to detect the gamma rays at the laboratory angle of 125°. The data presented are the double differential cross section, d^{2}sigma/dΩdE, for gamma-ray energies between 0.3 and 10.6 MeV for coarse intervals in incident neutron energy. The integrated yield of gamma rays of energies greater than 300 keV and higher resolution in the neutron energy is also presented. The experimental results are compared with the Evaluated Neutron Data Files (ENDF). 23 figures, cross section tables (auth)

11967 Two-nucleon transfer reactions induced by ^{16}O on ^{42}Ca and ^{40}Ca. Eisen, Y.; Fortune, H.T.; Henning, W.; Kovar, D.G.; Vigdor, S.; Zeidman, B. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* 13: No. 2, 699-711(Feb 1976).

The reactions ^{42},^{40}Ca(^{16}O,^{18}O)^{40},^{42}Ca and ^{42},^{40}Ca(^{16}O,^{14}O)^{44},^{46}Ti were studied at 56-MeV bombarding energy. Angular distributions for transitions to the ground and excited states of the residual nuclei and of the outgoing particles are analyzed in the framework of both "cluster" and microscopic distorted-wave Born-approximation calculations. The measured transfer cross sections are not described by calculations using optical-model parameters which fit elastic scattering. Agreement is substantially improved by a systematic change in the exit channel parameters. Cross sections for excited states relative to ground-state transitions are compared to relative strengths obtained from light-ion reactions and from simple shell-model calculations. (AIP)

11968 Heavy-ion L=1 transfer: A sensitive test of reaction theory. Bond, P.D.; Chasman, C.; Garrett, J.D.; Gelbke, C.K.; Hansen, O.; LeVine, M.J.; Schwarzschild, A.Z.; Thorn, C.E. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev. Lett.;* 36: No. 6, 300-303(9 Feb 1976).

Angular distributions presented for reactions ^{40},^{42},^{44}Ca(^{12}C, ^{14}N)^{39},^{41},^{43}K (transferred L=1) at 68-MeV bombarding energy are observed to oscillate out of phase with exact, finite-range, distorted-wave-Born-approximation (DWBA) calculations. It is shown that differential cross sections for L=1 transfer reactions are particularly sensitive tests of the DWBA. Simple arguments follow which indicate that the difficulty in fitting present data lies with our understanding of the reaction mechanism. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, THEORETICAL

MASS, ABUNDANCE, AND BINDING ENERGY

11969 Mass-excess predictions for neutron-rich isotopes near iron. Davids, C.N. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* 13: No. 2, 887-889(Feb 1976).

A mass equation due to Jelley et al. is used to predict the mass excesses of 42 isotopes near iron and the results are compared with other predictions and with experiments where possible. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 11949, 11986, 12067

11970 Effects of final-state charge exchange in the (π,πN) reaction on nickel targets. Monahan, J.E.; Serduke, F.J.D. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* **36**: No. 4, 224-225(26 Jan 1976).

It is shown that the ratios of one-nucleon-removal cross sections by π^+ and π^- recently measured for ^{58}Ni and ^{60}Ni targets are in resonable agreement with the Sternheim-Silbar modified impulse approximation that incorporates final-state-nucleon charge exchange. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 11973, 11974, 11975, 11976, 11977, 11979

11971 Blocking measurements of nuclear decay times. Gibson, W.M. (Bell Labs., Murray Hill, NJ). *Annu. Rev. Nucl. Sci.;* **25**: 465-508(1975).

After an examination of the relationship of blocking measurements to other types of lifetime measurements, the technique is discussed, citing typical examples. The analysis of lifetime data is considered using single-string continuum calculations, Monte Carlo simulations, and multistring continuum calculations. Use of the technique in resonance reactions, fission, inelastic scattering, and compound-elastic scattering is illustrated. 21 figures, 3 tables, 72 figures. (SDF)

ENERGY LEVELS AND TRANSITIONS

11972 (COO—535-733, pp 20-24) **Level structure of ^{75}Br.** Kluger, B.M.; Anderson, R.E.; Peterson, R.J.; Ristinen, R.A. 1 Nov 1975.

In Technical progress report and proposal for continuation of contract.

11973 Nuclear data sheets for A = 60. Kim, H.J. (Oak Ridge National Lab., TN). *Nucl. Data Sheets;* **16**: No. 3, 317-349(Nov 1975).

Experimental nuclear structure information available through May 1975 are compiled, and adopted properties are presented. Following the newly adopted procedure for presenting the information (see Nuclear Data Sheets for A = 75, Volume 16, Number 1, September 1975), results are directly produced from the Evaluated Nuclear Structure Data File (ENSDF). The present compilation represents an update of the previous work by S. Raman (Nuclear Data B2-5-41, 1968), cited as 68Ra36. Where possible, the data are presented in comparative level diagrams, thereby eliminating many tabular listings. Also, where no additional data which supersede or significantly modify the previous compilation have appeared since, only the values adopted from the latter are presented. (auth)

11974 Nuclear data sheets for A = 65. Auble, R.L. (Oak Ridge National Lab., TN). *Nucl. Data Sheets;* **16**: No. 3, 351-382(Nov 1975).

Nuclear structure data available through July 1975 are compiled, and adopted level properties are given. The bulk of the data are presented pictorially for easy comparison. Experimental details, references, and additional comments, where required, are given in the text. All drawings, tables, and comments are reproduced from the computerized Evaluated Nuclear Structure Data File (ENSDF). Any additions or corrections desired by the users should be addressed to the compilers for maintenance and updating of the computer file. (auth)

11975 Nuclear data sheets for A = 66. Auble, R.L. (Oak Ridge National Lab., TN). *Nucl. Data Sheets;* **16**: No. 3, 383-416(Nov 1975).

Nuclear structure data available through July 1975 are compiled, and adopted level properties are given. The bulk of the data are presented pictorially for easy comparison. Experimental details, references, and additional comments, where required, are given in the text. All drawings, tables, and comments are reproduced from the computerized Evaluated Nuclear Structure Data File (ENSDF). Any additions or corrections desired by the users should be addressed to the compilers for maintenance and updating of the computer file. (auth)

11976 Nuclear data sheets for A = 67. Auble, R.L. (Oak Ridge National Lab., TN). *Nucl. Data Sheets;* **16**: No. 3, 417-444(Nov 1975).

Nuclear structure data available through July 1975 are compiled, and adopted level properties are given. The bulk of the data are presented pictorially for easy comparison. Experimental details, references, and additional comments, where required, are given in the text. All drawings, tables, and comments are reproduced from the computerized Evaluated Nuclear Structure Data File (ENSDF). Any additions or corrections desired by the users should be addressed to the compilers for maintenance and updating of the computer file. (auth)

11977 Nuclear data sheets for A = 89. Kocher, D.C. (Oak Ridge National Lab., TN). *Nucl. Data Sheets;* **16**: No. 3, 445-505(Nov 1975).

The 1961 version of Nuclear Data Sheets for A = 89 and the 1970 Midstream Evaluation, A = 89 [M. W. Johns, J. Y. Park, S. M. Shafroth, D. M. Van Patter, and K. Way, Nuclear Data Tables 8, 373 (1970)], have been revised on the basis of experimental data received prior to August 1, 1975. Results from approximately 150 papers and communications chosen from the extensive literature for this A—chain have been included in the present evaluation. Numerous additional references dealing with reaction mechanism studies and nuclear structure theory are not included in this compilation, but are available upon request from the Nuclear Data Project. Data on nine A = 89 nuclei are presented. Only the half-lives for ^{89}Se and ^{89}Br have been determined. The decay schemes for ^{89}Kr and ^{89}Rb appear to be well established. The decay scheme for ^{89}Sr is particularly simple, but the intensity for the single γ-ray in the decay is not well known. Many spin assignments have been made for levels in ^{89}Sr, ^{89}Y, and ^{89}Zr from a variety of decay and reaction studies. The decay schemes for low—spin and high—spin isomers in both ^{89}Zr and ^{89}Nb appear to be well established, but the energy ordering of the two isomers in ^{89}Nb is not known. On the basis of recent results, it appears that the previously claimed isotope ^{89}Mo has not yet been observed.

11978 Neutron pickup on ^{84}Kr. Medsker, L.R.; Fortune, H.T.; Bishop, J.N. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174). *Phys. Rev., C;* **13**: No. 1, 105-108(Jan 1976).

The ^{84}Kr(^{3}He,α)^{83}Kr reaction has been studied at a bombarding energy of 18 MeV. The isotopically enriched ^{84}Kr target was contained in a gas cell with no entrance window. Excitation energies and angular distributions were obtained for 16 levels up to 2735 keV excitation energy in $^{83}_{36}Kr_{47}$. A distorted-wave analysis was used to determine l values and spectroscopic strengths. The pickup of neutrons from 1g, 2p, and 1f orbitals was observed. (AIP)

11979 Levels of ^{83}Kr populated in the decay of ^{83}Rb and ^{83}Br. Vaisala, S.; Graeffe, G.; Heinonen, J.; Delucchi, A.A.; Meyer, R.A. (Laboratory of Physics, The Helsinki University of Technology, Otaniemi, Finland). *Phys. Rev., C;* **13**: No. 1, 372-376(Jan 1976).

The levels of ^{83}Kr were studied from the decay of both ^{83}Rb and ^{83}Br. Thirteen γ rays were observed in the decay of ^{83}Rb and eight in the decay of ^{83}Br. The ground-state M2 transition from the 562-keV level was observed to have a branching ratio of 1.4×10^{-4}. The conversion coefficients were measured for the 9.39 keV and for the 32.2-keV transition. Decay schemes are presented and the possible spins, parities, and structure for the levels of ^{83}Kr are discussed. (AIP)

11980 Nuclear data sheets for A = 69. Auble, R.L. (Oak Ridge National Lab., TN). *Nucl. Data Sheets;* **17**: No. 2, 193-224(Feb 1976).

Nuclear structure data available through September 1975 are compiled, and adopted level properties are given. The bulk of the data are presented pictorially for easy comparisons. Experimental details, references, and additional comments, where required, are given in the text. All drawings, tables, and comments are reproduced from the computerized Evaluated Nuclear Structure Data File (ENSDF). Any additions or corrections desired by the users should be addressed to the compilers for maintenance and updating of the computer file. (auth)

11981 Lifetime measurements to test the coexistence of spherical and deformed shapes in ^{72}Se. Hamilton, J.H.; Crowell, H.L.; Robinson, R.L.; Ramayya, A.V.; Collins, W.E.; Ronningen, R.M.; Maruhn-Rezwani, V.; Maruhn, J.A.; Singhal, N.C.; Kim, H.J.; Sayer, R.O.; Magee, T.; Whitlock, L.C. (Physics Department, Vanderbilt University, Nashville, Tennessee 37235). *Phys. Rev. Lett.;* **36**: No. 6, 340-342(9 Feb 1976).

Mean lives of the 4^+ to (12^+) yrast states in ^{72}Se populated in the reaction ^{58}Ni(^{16}O,2p) were extracted from a line-shape analysis of the Doppler-broadened lines. The results strongly support the interpretation of the crossing of states built on near-spherical and deformed shapes in the yrast cascade. A least-squares fit of a collective Hamiltonian to the experimental data yielded a potential

energy surface with spherical and strongly deformed prolate minima. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 11927, 11940, 11953, 11955, 11972, 12004

11982 (COO—535-733, pp 25-28) **Search for two-step process in the Ni(p,t) reactions.** Schneider, M.J.; Burch, J.D.; Kunz, P.D. 1 Nov 1975.

In Technical progress report and proposal for continuation of contract.

11983 (COO—535-733, pp 33-35) **^{64}Ni(α,^{6}He)^{62}Ni reaction.** Shepard, J.R.; Cecil, F.E.; Anderson, R.E. 1 Nov 1975.

In Technical progress report and proposal for continuation of contract.

11984 (COO—535-733, pp 46-48) **Study of the ^{60}Ni(^{3}He,t)^{62}Cu reaction.** Schneider, M.J.; Rudolph, H.; Zimmerman, W.R. 1 Nov 1975.

In Technical progress report and proposal for continuation of contract.

11985 (COO—535-733, pp 72-73) **Study of the ^{89}Y(p,n) reaction to the anti-analog and analog states of ^{89}Zr.** Wieman, H.H.; Anderson, R.E.; Cecil, F.E.; Lind, D.A.; Leth, S.; Zafiratos, C.D. 1 Nov 1975.

In Technical progress report and proposal for continuation of contract.

11986 (COO—2439-2) **High resolution neutron total cross section measurements with the (A) ORNL linac and (B) the Columbia University's Nevis Synchrocyclotron and (C) with B.N.L. HFBR. Progress report, April 1, 1975—March 31, 1976.** Garg, J.B. (State Univ. of New York, Albany (USA). Dept. of Physics). Dec 1975. Contract AT(11-1)-2439. 37p. Dep. NTIS $4.00.

The research involved the measurement, analysis and interpretation of high resolution neutron total and partial cross sections in the neutron energy range of few eV to few hundred keV in the following nuclei: Bi, Ta, Natural Copper, Natural Zinc, separated isotopes of copper, iron and zinc, e.g., ^{54}Fe, ^{56}Fe, ^{58}Fe, ^{63}Cu, ^{65}Cu, ^{64}Zn, ^{66}Zn, ^{67}Zn, ^{68}Zn, ^{70}Zn and Mn, Co, V. Some of these measurements were performed with the Columbia University's neutron velocity selector and the measurements on separated isotopes of iron, copper and zinc were performed with the Oak Ridge electron linear accelerator. By using area and shape analysis of resonances, the data were analyzed to extract the values of resonance parameters such as resonance energies (E/sub o/), neutron widths (A/sub n/), capture widths (A/sub γ/) etc. The systematics of these results were investigated in detail. The results of these investigations have been submitted for publication in professional journals. (auth)

11987 **Mechanisms of heavy-ion induced (p,n) - and (n,p) -type reactions.** Weisfield, M.W.; Williams, R.A.; Caretto, A.A. Jr. (Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Phys. Rev., C;* **13**: No. 1, 128-132(Jan 1976).

Excitation functions and recoil ranges for the reactions ^{65}Cu(^{12}C,X)^{65}Zn and ^{65}Cu(^{11}B,X)^{65}Zn were measured for ^{12}C ion energies between 43 and 122 MeV and for ^{11}B ion energies between 60 and 115 MeV. The angular distribution for the production of ^{65}Zn by the ^{65}Cu(^{12}C,X)^{65}Zn reaction was determined at 88.6 MeV. The forward projected recoil ranges are not in satisfactory agreement with ranges which would be predicted on the basis of the complete fusion compound nucleus mechanism nor apparently with a simple kinematic treatment of the quasielastic scattering model. The experimental results appear to be consistent with a charge-exchange or nucleon transfer mechanism in which the distance of closest approach varies inversely with incident energy. Evidence for the enhancement of isospin $\Delta T = 0$ transitions to target analog states is suggested in that only an upper limit could be placed on the production of cross sections of ^{65}Ni, a ΔT not-equal to 0 product, compared to high yields for ^{65}Zn, a $\Delta T = 0$ product. (AIP)

11988 **Charged particle Q-value measurements in the iron region.** Jolivette, P.L.; Goss, J.D.; Bieszk, J.A.; Hichwa, R.D.; Browne, C.P. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). *Phys. Rev., C;* **13**: No. 1, 439(Jan 1976).

Q values are reported for the 11 reactions ^{63,65}Cu,^{64,66}Zn, ^{70}Ge(p,α); ^{46,48,50}Ti(d,p); ^{50}Cr,^{64}Zn(d,t), and ^{54}Fe(d,α). Uncertainties range from +-0.8 to +-2.2 keV. Only the ^{50}Cr(d,t)^{48}Cr value differs greatly (61 keV) from the values in the 1971 Atomic Mass Evaluation, but in nine cases uncertainties were reduced by factors ranging from 1.5 to 6. The Ti(d,p) measurements are consistent with (n,γ) values. (AIP)

11989 **Fast-neutron total and scattering cross sections of elemental nickel.** Guenther, P.; Smith, A.; Whalen, J. (Argonne National Lab., IL). *Nucl. Sci. Eng.;* **59**: No. 2, 106-116(Feb 1976).

Fast-neutron total and scattering cross sections of elemental nickel are measured. Total neutron cross sections are determined from 0.25 to 5.0 MeV with incident neutron resolutions of a few keV. Differential neutron elastic scattering cross sections are measured from incident energies of 0.3 to 4.0 MeV at intervals of less than or equal to 200 keV. Cross sections for the neutron excitation of states at 1.156 +- 0.015, 1.324 +- 0.015, 1.443 +- 0.015, 2.136 +- 0.013, 2.255 +-0.030, 2.449 +- 0.030, 2.614 +- 0.020, and 2.791 +- 0.025 MeV are determined to incident energies of 4.0 MeV. The experimental results are examined in the context of optical and statistical models including resonance width-fluctuation and correlation effects. The present experimental results are compared with previously reported measured values and with the evaluated data file ENDF/B-IV. 6 figures, 1 table. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

11990 **Semiclassical and quantum mechanical aspects of one- and two-nucleon transfer.** Scott, D.K.; Hendrie, D.L.; Kraus, L.; Maguire, C.F.; Mahoney, J.; Terrien, Y.; Yagi, K. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **36**: No. 4, 226-229(26 Jan 1976).

A criterion for semiclassical or quantum-mechanical behavior in heavy-ion reactions is derived in terms of the number of contributing partial waves. The predictions are compared with one- and two-nucleon transfer reactions induced by 78-MeV ^{12}C ions on ^{144}Nd. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 11997

11991 (IS-T—707) **Gamma-ray decay schemes for ^{83}Kr, ^{83}Rb, and ^{85}Sr.** Bischof, C.J. (Ames Lab., Iowa (USA)). Jan 1976. Contract W-7405-eng-82. 158p. Dep. NTIS $6.00.

Thesis.

A study of the gamma-ray de-excitation following the beta decays of ^{83}Kr, ^{83}Rb, and ^{85}Sr using the TRISTAN on-line separator facility is reported. Gamma-ray singles and gamma-gamma coincidence measurements were made using Ge(Li) detectors. Of the 162 gamma rays observed in the decay of ^{85}Sr, 143, representing more than 99 percent of the total gamma-ray intensity observed, were placed in a level scheme containing 36 levels. For the decay of ^{83}Rb, 243 gamma rays were observed, of which 231 are placed in a level scheme consisting of 74 levels. This again represents a placement of over 99 percent of the total gamma-ray intensity measured. In the case of the ^{83}Kr decay approximately 98.5 percent of the observed gamma-ray intensity has been accounted for by the proposed level scheme. This results from the placement of 203 of the 217 gamma rays assigned to this decay in a level scheme comprising 56 levels. Beta-branching for these decays were determined from transition intensity balances. Spin and parity assignments were proposed, whenever possible, on the basis of gamma-ray transition probabilities and deduced log ft values. A comparison is made with the available reaction data for the ^{85}Y level scheme. In all cases an attempt has been made to explain some of the levels in terms of the nuclear shell model and decay systematics. 18 figures, 20 tables, 68 references. (auth)

11992 **Hindered beta decay of ^{99}Nb/subm/ and the decay sequence ^{99}Zr yields^{99}Nb/sub m,g/yields^{99}Mo.** Hopke, P.K.; Meyer, R.A. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., C;* **13**: No. 1, 434-436(Jan 1976).

A study of the decay of ^{99}Nb/supm/ has revealed hindered β decay to known levels in ^{99}Mo at (log ft value in parentheses):

204.12 (9.36), 786.19 (9.11), 820.61 (10.6), and 1039.25 keV (>10.2). The β transitions to these levels are found to be 2 to 3 orders of magnitude slower than those observed in the decay of ^{98}Tc/supm/. This difference is discussed in terms of the shell model states available to ^{98}Nb, ^{98}Mo, and ^{98}Tc. (AIP)

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 11991, 11992, 12000

11993 (JUL-Conf—16(Vol.1), pp 48) **Possible coexistence of prolate and oblate shapes in ^{122}Ba.** Gizon, J.; Gizon, A.; Horen, D.J. (Institut des Sciences Nucleaires, Grenoble, France). Jul 1975.

From Conference on highly excited states of nuclei; Julich, F.R. Germany (22 Sep 1975).

In International symposium on highly excited states in nuclei, Juelich, 23—26 September 1975. Volume 1.

11994 (TID—26945) **Levels in ^{113} ^{115}In as seen by the Coulomb excitation and (HI,xn) reactions.** Tuttle, W.K. III. (Tennessee Univ., Knoxville (USA)). Dec 1975. 138p. Dep. NTIS $6.00.

Thesis.

Having one proton hole in a major proton shell closing at Z = 50 makes the odd mass indium nuclei prime candidates for description by the weak coupling model. The purpose of the Coulomb excitation study was to update the information on ^{115}In and to do a thorough study of ^{113}In for which little information is known. In the (HI,xn) study, it was hoped that the deformed rotation band could be found. For the Coulomb excitation measurements, four types of experiments were performed. First, using beams of 9.4, 10.0, and 10.6 MeV ^{4}He ions, γ-ray yields were taken with an angle between the beam and the detector, theta, of 55°. With these data one can confirm existing level diagrams, look for new transitions, and measure B(E2)'s and branching ratios. Secondly, γ-γ coincidence measurements were performed with a 10.6 MeV ^{4}He beam to confirm the level diagrams and search for new transitions. Next, angular distributions were taken for a 10.0 MeV ^{4}He ion beam to determine spins, parities and mixing ratios. Finally, a beam of ^{16}O ions was used to determine the lifetimes of states whose decaying γ rays showed Doppler broadening. For the ^{110}Pd(^{6}Li,3n)^{113}In measurements, two types of experiments were performed, both with a 24 MeV ^{6}Li beam. First γ-γ coincidences were performed to find new transitions feeding those states previously known. Next, angular distributions were performed to confirm old spin assignments and to establish a basis for assignments to new levels observed. (auth)

11995 **Nuclear data sheets for A = 118.** Carlson, G.H. (Ames Lab., IA); Talbert, W.L. Jr.; Raman, S. (Ames Lab., IA). *Nucl. Data Sheets;* 17: No. 1, 1-37(Jan 1976).

The 1960 version of the Nuclear Data Sheets for A = 118 has been revised on the basis of experimental data received before September 1973, with some later modifications. Experimental data concerning the nuclear structure of ten isotopes were compiled and used in the construction of the level schemes and J/sup π/-assignments. (auth)

11996 **Nuclear data sheets for A = 120.** Kocher, D.C. (Oak Ridge National Lab., TN). *Nucl. Data Sheets;* 17: No. 1, 39-95(Jan 1976).

The 1960 version of Nuclear Data Sheets for A = 120 has been revised on the basis of experimental data received prior to September 1, 1975. Results from approximately 130 papers and communications have been included in the present evaluation. Data on ten A = 120 nuclei are presented. Two β-decaying isomers are known for each of the odd-odd nuclei ^{120}Ag, ^{120}In, ^{120}Sb, and ^{120}I. Only for ^{120}Ag is the energy ordering of the two isomers known, and only for ^{120}In and ^{120}Sb are the decay schemes for the two isomers well determined. With the exception of ^{120}I, other excited levels in these odd-odd nuclei have not been identified. Reaction studies to determine excited levels in ^{120}Sb would seem particularly appropriate. Other than a half-life, little is known about the remaining odd-odd nucleus, ^{120}Cd. For the even-even nuclei, the decay scheme for ^{120}Cd is somewhat uncertain, although it is likely that most of the decay directly feeds the 1^+ isomer in ^{120}In. Many levels in stable ^{120}Sn and ^{120}Te are known from a variety of decay and reaction studies. The complex decay scheme for ^{120}Xe appears well determined, but little is known about ^{120}Ba decay. A few excited levels for ^{120}Xe and ^{120}Ba comprising rotational bands have been proposed from in-beam γ-ray spectroscopy. (auth)

11997 **States in ^{120}Sb populated in the β decay of 10^5-yr ^{120}Sn.** Smith, H.A. Jr.; Bunker, M.E.; Starner, J.W.; Orth, C.J.; Lobner, K.E.G. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). *Phys. Rev., C;* 13: No. 1, 387-398(Jan 1976).

The low-energy level structure of the odd-odd nucleus ^{120}Sb has been investigated by studying the radioactive decay of 10^5-yr ^{120}Sn, by using Ge(Li) and Si(Li) detectors. From conversion-electron and γ-ray singles data, γ-γ and γ-e$^-$ prompt and delayed coincidence measurements, and complementary γ-ray energy and intensity balance arguments, a decay scheme for ^{120}Sn has been deduced which accommodates all of the observed γ-ray transitions. The energies (keV), spins, and parities of the levels established in ^{120}Sb are as follows: 0.0 [8$^-$], 17.7 [5$^+$], 40.4 [3$^-$], 83.1 [4$^-$, (3$^-$)], 104.7 [3$^+$], and 128.0 [2$^+$]. The respective half-lives of these six states are: 12.4 day, 19.0 min, ≅11 s, 5.1 ns, 553 ns, and 78.0 ns, the latter four values having been determined in the present investigation. The level assignments are discussed within the framework of the single-particle shell model and in relation to the proposed assignments of low-lying energy levels of neighboring odd-odd antimony isotopes. (AIP)

11998 **Levels in the three-hole nucleus ^{105}Ag and the decay of 55.5-min ^{105}Cd.** Jackson, S.V.; Walters, W.B.; Meyer, R.A. (Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Rev., C;* 13: No. 2, 803-830(Feb 1976).

The γ-ray spectrum following the decay of 55.5-min ^{105}Cd to levels of ^{105}Ag has been studied by singles, coincidence, and Compton-suppressed γ-ray spectroscopy. Sources were prepared by the (n,2n) reaction on isotopically enriched ^{106}Cd sources using 14-MeV neutrons. A total of 274 γ rays are attributed to the decay of ^{105}Ag, and ~248 are placed in a level scheme involving 53 excited states. These data along with the results of (^{3}He,d) and (p,t) reaction studies were utilized to make spin and parity assignments for many of the levels. The systematics of the Z=47 silver nuclides are compared with various theoretical calculations and the systematics among the N=58 isotones are discussed. (AIP)

11999 **Nuclear data sheets for A = 132.** Hiddleston, H.R.; Browne, C.P. (Univ. of Notre Dame, IN). *Nucl. Data Sheets;* 17: No. 2, 225-286(Feb 1976).

All information concerning nuclei with A = 132 received prior to January 1975 has been evaluated and compiled. This report supersedes the 1961 version of Nuclear Data Sheets for A = 132. (auth)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 11366, 11927, 11940, 11953, 11955, 11994, 11998

12000 (COO—535-733, pp 10-13) **Odd—odd nuclei in the mass 100 region: ^{100}Rh.** Anderson, R.E.; Kraushaar, J.J.; Kluger, B.M. 1 Nov 1975.

In Technical progress report and proposal for continuation of contract.

12001 (COO—535-733, pp 76-81) **(^{3}He,n) reaction near Z = 50.** Fielding, H.W.; Anderson, R.E.; Zafiratos, C.D.; Lind, D.A.; Alford, W.P.; Cecil, F.E.; Weiman, H.H.; Leth, S.C. 1 Nov 1975.

In Technical progress report and proposal for continuation of contract.

12002 **Total spin measurement of proton hole states by the (t, α) reaction.** Flynn, E.R.; Hardekopf, R.A.; Sherman, J.D.; Sunier, J.W.; Coffin, J.P. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev. Lett.;* 36: No. 2, 79-81(12 Jan 1976).

It is shown that it is possible to measure the total angular momentum of proton hole states by means of the (t, α) reaction using a recently developed polarized triton source. The reactions ^{90}Zr(t, α)^{89}Y and ^{208}Pb(t, α)^{207}Tl have been studied at 17-MeV bombarding energies and show large differences in the analyzing powers between spin-orbit partners $p_{1/2}$ and $p_{3/2}$ in the former case and $d_{3/2}$ and $d_{5/2}$ in the latter case. It is concluded that measurement of asymmetries in (t, α) reactions is a powerful technique to assign both l and j transfer for proton-pickup reactions. (AIP)

12003 **Multistep processes in the inelastic scattering of 70.4-MeV ^{12}C from ^{144}Nd.** Hillis, D.L.; Gross, E.E.; Hensley, D.C.; Rickertsen, L.D.; Bingham, C.R.; Scott, A.; Baker, F.T. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev. Lett.;* 36: No. 6, 304-306(9 Feb 1976).

Inelastic scattering of ^{12}C projectiles from ^{144}Nd has been studied at an incident energy of 70.4 MeV. The differential cross sections for exciting low-lying collective states of the target and projectile are compared to distorted-wave Born-approximation (DWBA) and coupled-channels calculations. Standard DWBA calculations using known Coulomb matrix elements fail to fit the data. Coupled-channels calculations, however, can account for

these data and show a strong sensitivity to target and projectile reorientation matrix elements. (AIP)

SPONTANEOUS AND INDUCED FISSION

12004 Critical asymmetry and the systematics of fission-like processes in the reactions of ^{12}C projectiles with medium mass nuclei. Natowitz, J.B.; Namboodiri, M.N.; Chulick, E.T. (Cyclotron Institute and Department of Chemistry, Texas A and M University, College Station, Texas 77843). *Phys. Rev., C;* 13: No. 1, 171-181(Jan 1976).

The systematics of fission-like processes observed in reactions induced by 107- and 197-MeV ^{12}C projectiles have been investigated. Counter telescopes were employed to detect and identify the products of reactions with ^{89}Y, ^{92}Mo, Ag, and ^{116}Sn. Limited experiments using Ni and Au targets were also performed. For the medium mass targets cross sections, energy distributions, and angular distributions of the reaction products are reported. Limiting angular momenta for the fusion of ^{12}C with Y, Mo, and Ag have been determined and are used to estimate the angular momenta of the collisions leading to fission-like reactions. The probability of occurrence of such reactions is compared with predictions based upon the concept of an angular momentum dependent critical asymmetry. This concept is found to be very useful in discussing the reaction mechanisms involved. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

12005 (JUL-Conf—16(Vol.1), pp 61) **Microscopic study of γrast band in Yb-nuclei.** Ring, P.; Dafali, H.R.; Mang, H.J. (Univ. of California, Berkeley). Jul 1975.

From Conference on highly excited states of nuclei; Julich, F.R. Germany (22 Sep 1975).

In International symposium on highly excited states in nuclei, Juelich, 23—26 September 1975. Volume 1.

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 12010

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 12012

12006 (JUL-Conf—16(Vol.1), pp 68) **High-spin level structure in ^{180} ^{184}Pt.** Daly, P.J. (Purdue Univ., Lafayette, IN); Piiparinen, M.; Cunnane, J.C.; Saha, S.K.; Dors, C.L.; Bernthal, F.M.; Khoo, T.L. Jul 1975.

From Conference on highly excited states of nuclei; Julich, F.R. Germany (22 Sep 1975).

In International symposium on highly excited states in nuclei, Juelich, 23—26 September 1975. Volume 1.

12007 (JUL-Conf—16(Vol.1), pp 76) **High spin octupole states in formed nuclei.** Vogel, P. (California Inst. of Tech., Pasadena). Jul 1975.

From Conference on highly excited states of nuclei; Julich, F.R. Germany (22 Sep 1975).

In International symposium on highly excited states in nuclei, Juelich, 23—26 September 1975. Volume 1.

12008 (UCRL-Trans—10753) **Nuclear states in ^{186}Re excited by the (n,γ) reaction.** Glatz, J. Translated from *Z. Phys.;* 265: 335-364(1973). 41p. Dep. NTIS $4.00.

Prompt and delayed γ-γ-coincidences were measured after slow neutron capture in ^{185}Re by the use of Ge(Li)-detectors. New isomers were found at 99.4 keV (Y/sub $^1/_2$/ = 27 +- 7 nsec) and at approximately 330 keV (T/sub $^1/_2$/ = 17.4 +- 0.7 nsec). Evaluation of the coincidence data established 10 rotational bands with band heads below 700 keV. The level scheme is discussed in detail: Nilsson assignments are proposed for the band configurations, and calculations of Coriolis mixing and γ-transition probabilities are presented which reproduce the experimental level energies and transition intensities very satisfactorily. 9 tables, 8 figures. (auth)

12009 Nuclear data sheets for A = 167. Harmatz, B. (Oak Ridge National Lab., TN). *Nucl. Data Sheets;* 17: No. 1, 143-192(Jan 1976).

The literature on all nuclei with mass number A = 167 has been reviewed, and the nuclear structure information is summarized here. The level properties obtained from various reaction and decay experiments are shown in the drawings, and Nilsson—state assignments are given. (auth)

12010 N=85 nuclei. I. Decay of ^{145}Pr to levels of ^{145}Nd. Jackson, S.V.; Meyer, R.A. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., C;* 13: No. 1, 339-347(Jan 1976).

A γ-ray spectroscopy study of the decay of ^{145}Pr has led to the identification of 61 γ rays. These and γ-γ coincidence studies have been used to identify 20 levels in ^{145}Nd at (J/sup π/ value in parentheses): ground state (7/2$^-$), 67.1 (3/2$^-$), 72.50 (5/2$^-$), 657.67 (11/2$^-$), 748.28 (9/2$^-$), 780.45 (3/2$^-$), 919.9 (1/2$^-$), 920.72 (9/2$^-$), 937.05 (5/2$^-$), 1011.22 (11/2$^-$), 1051.41 (7/2$^-$), 1085.2 (3/2$^+$), 1150.26 (9/2^{+-}), 1101.05 (5/2$^-$), 1161.05 (5/2$^-$), 1162.32 (-), 1249.7 (5/2$^-$), 1285.6 (-), 1338.6 (-), 1403.92 (5/2$^-$), and 1527.05 (9/2$^-$) keV. These levels and their properties are discussed in terms of the clustering and the dressed n-quasiparticle model. (AIP)

12011 Nuclear data sheets for A = 179. Henry, E.A. (Univ. of California, Livermore). *Nucl. Data Sheets;* 17: No. 2, 287-328(Feb 1976).

Nuclear data for the 10 known members of the A = 179 mass chain are compiled. Included in the compilation are drawings presenting most of the experimental data. Summary Sheets showing adopted level and gamma-ray properties, and Data Sheets tabulating the experimental data. Also included are data on the alpha decay of members of the A = 183 mass chain. For brevity, gamma-gamma-coincidence data and some reaction results are presented only on the drawings. This compilation is based on references received before June 1975. Substantial detail is known for the level structures of ^{179}Hf, ^{179}Ta, ^{179}W, and, to a lesser extent ^{179}Re. The levels of ^{179}Hf are well studied by beta decay, (n,γ) reactions, and isomer decay. The charged-particle reactions leading to levels in ^{179}Hf lack definitive l-transfer values. Beta decay and in-beam gamma-ray spectroscopy which populate levels in ^{179}Ta and ^{179}W are reported. Levels in ^{179}Re have been studied by in-beam gamma-ray spectroscopy. Beta decay of ^{179}Os to levels in ^{179}Re is now being studied. Nothing is known about excited levels in ^{179}Lu, ^{179}Os, ^{179}Ir, ^{179}Pt, ^{179}Au, or ^{179}Hg. (auth)

MOMENTS AND SPIN

12012 Moments of inertia in ^{168}Yb at very high spins. Simon, R.S.; Banaschik, M.V.; Colombani, P.; Soroka, D.P.; Stephens, F.S.; Diamond, R.M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* 36: No. 7, 359-361(16 Feb 1976).

Two methods have been used to obtain values of the effective moment of inertia of very-high-spin (20h-bar—50h-bar) states populated in heavy-ion compound-nucleus reactions. The ^{168}Yb nucleus studied has effective moments of inertia smaller than, but approaching, the rigid-body estimate. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 11793, 12008

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 11949

12013 Evaluation of neutron and gamma-ray-production cross-section data for lead. Fu, C.Y.; Perey, F.G. (Oak Ridge National Lab., TN). *At. Data Nucl. Data Tables;* 16: No. 5, 409-450(Nov 1975).

A survey was made of the available information on neutron and gamma-ray-production cross-section measurements of lead. From these and from relevant nuclear-structure information on the Pb isotopes, recommended neutron cross-section data sets for lead covering the neutron energy range from 0.00001 eV to 20.0 MeV

have been prepared. The cross sections are derived from experimental results available to February 1972 and from calculations based on optical-model, DWBA, and Hauser—Feshbach theories. Comparisons which show good agreement between theoretical and experimental values are displayed in a number of graphs. Also presented graphically are smoothed total cross sections, Legendre coefficients for angular distributions, and a representative energy distribution of gamma rays from resonance capture. 15 tables, 36 figures, 104 references. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 12015

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 12006, 12017, 12018, 12020, 12023

12014 (JUL-Conf—16(Vol.1), pp 73) **High spin states populated by the (d,α) reaction on ^{204}Pb, ^{206}Pb, and ^{208}Pb at 80 MeV.** Didelez, J.P. (Univ. of Maryland, College Park); Chang, C.C.; Chant, N.S.; Steinberg, R.I.; Wu, J.; Frascaria, N. Jul 1975.

From Conference on highly excited states of nuclei; Julich, F.R. Germany (22 Sep 1975).

In International symposium on highly excited states in nuclei, Juelich, 23—26 September 1975. Volume 1.

12015 **Electron-capture decay of ^{208}Po.** Jardine, L.J.; Shihab-Eldin, A.A. (University of California, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Phys. Rev., C;* 13: No. 1, 348-360(Jan 1976).

The energies and intensities of 77 γ-ray transitions assigned to the electron-capture decay of ^{208}Po have been measured. Multipolarities of transitions were determined from internal conversion coefficients calculated from our relative γ-ray intensities and the relative conversion electron intensities of Fujika, Kanbe, and Hisatake. γ-ray singles, γ-γ coincidence, and previous conversion electron measurements were used to construct a more complete decay scheme for ^{208}Po. Data obtained from in-beam reaction studies, ^{210}At α decay studies, and the present electron-capture decay scheme were used to identify states in ^{208}Bi of a one proton particle-three neutron hole character. In addition a qualitative discussion of the level structure of ^{208}Bi generated from (zero-order) couplings of $1h_{9/2}$ and $2f_{7/2}$ protons with the low-lying states of ^{208}Pb is given, and this is compared with reasonable success to the experimental spectrum. The dominant electron-capture decay rates are explained in terms of an allowed single-particle mechanism. (AIP)

12016 **Nuclear data sheets for A = 216.** Ellis, Y.A. (Oak Ridge National Lab., TN). *Nucl. Data Sheets;* 17: No. 3, 329-339(Mar 1976).

Nuclear structure information for all nuclei with mass number A = 216 is summarized. Evaluated data and the adopted levels and spin and parity assignments are given. Only the α-decay mode has been observed for all nuclei in this mass chain. Possible epsilon-capture and/or β-decay are expected to be quite weak for most of them. An upper limit of 0.6 percent was set by 68Val8 for ^{216}Th epsilon-decay from α-yields. The compilers estimate any epsilon-capture decay from ^{216}At to ^{216}Po to be less than 1.5×10^{-6} percent; similarly, β-decay from ^{216}At to ^{216}Rn ground state is expected to be less than 0.0004 percent, and allowed β^- to any yet unobserved level in ^{216}Rn can be estimated to be less than 0.005 percent from expected log ft values. Level scheme information for all nuclei is from α-decays of their parents with A = 220. α-parents are shown on the drawings above their daughters. α-decay data are given as much as possible on the drawings. For data with uncertainties and references, see A = 220 compilation in this issue. (auth)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 11793, 11986, 12002, 12014, 12043, 12052

12017 (COO—535-733, pp 5-7) **(^{3}He,d) reaction on platinum.** Munger, M.L.; Peterson, R.J.; DiGiacomo, N.; Smith, G. 1 Nov 1975.

In Technical progress report and proposal for continuation of contract.

12018 (JUL-Conf—16(Vol.1), pp 77) **Coulomb excitation of ^{238}U with heavy ions and the rotation vibration coupling at high angular momenta.** Grosse, E.; de Boer, J.; Diamond, R.M.; Stephens, F.S; Tjoem, P. (Univ. of California, Berkeley). Jul 1975.

From Conference on highly excited states of nuclei; Julich, F.R. Germany (22 Sep 1975).

In International symposium on highly excited states in nuclei, Juelich, 23—26 September 1975. Volume 1.

12019 **(^{3}He,2p) reaction on ^{208}Pb.** Gavron, A. (Department of Physics, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., C;* 13: No. 1, 98-104(Jan 1976).

The angular distribution and relative energy of the proton pair emitted in the ^{208}Pb(^{3}He,2p) reaction was measured by a simple technique involving a single semiconductor telescope. The experimental results indicate that the final state interaction between the two protons is small when compared to the interaction between the target nucleus and each one of the protons. (AIP)

12020 **Neutron resonance spectroscopy: ^{209}Bi.** Singh, U.N.; Rainwater, J.; Liou, H.I.; Hacken, G.; Garg, J.B. (Columbia University, New York, New York 10027). *Phys. Rev., C;* 13: No. 1, 124-127(Jan 1976).

Neutron total cross section vs energy measurements were made for several thicknesses of bismuth metal. The results of the resonance parameter evaluation for 30 levels (12 s and 18 p) to 75 keV are given. Parameters for the p levels and for three weak s levels were determined using a transmission area analysis. An R-matrix multilevel shape analysis fitting was used to obtain the final choice resonance parameters for the nine dominant l=0 levels. The experimental points and R-matrix fit curve to 75 keV are shown. The (E_o,J,Γ/subn/) choices for these nine levels are (0.800, 5, 4.6), (2.312, 4, 19.5), (5.112, 5, 5.4), (12.15, 4, 270), (15.54, 4, 118), (27.08, 4, 24), (33.34, 4, 240), (45.58, 5, 160), and (69.18, 5, 520), where E_o is in keV and Γ/subn/ is in eV. On the basis of these levels, we obtain for the s and p strength functions 10^4S_o= (0.62/sup +0.36//sub -0.20//) and 10^4S_1= (0.13/sup +0.06//sub -0.04/).. A channel radius of 9 fm was used to calculate S_1, and the evaluation ignores the possibility that some p levels were missed below 75 keV. (AIP)

12021 **Elastic scattering of ^{40}Ar and ^{84}Kr on ^{209}Bi and ^{238}U at 7.2 and 8.5 MeV/N.** Birkelund, J.R.; Huizenga, J.R.; Freiesleben, H.; Wolf, K.L.; Unik, J.P.; Viola, V.E. Jr. (Departments of Chemistry and Physics, University of Rochester, Rochester, New York 14627). *Phys. Rev., C;* 13: No. 1, 133-146(Jan 1976).

Cross sections for elastic scattering of ^{40}Ar on targets of ^{209}Bi and ^{238}U were measured at energies of 286 and 340 MeV. Cross sections for the elastic scattering of ^{84}Kr on ^{209}Bi were measured at energies of 600 and 712 MeV. These experimental elastic scattering data were fitted with optical and Fresnel models. The total reaction cross section deduced from the Fresnel model by the one-quarter point technique agrees within a few percent with the result from the optical model. The Fresnel interaction radius and the optical model strong absorption radius are found to be approximately equal and qualitatively reproduced by the sum of the half-density electron scattering radii of the two heavy ions and a constant of 3.2+-0.3 fm. A method of estimating total reaction cross sections for heavy ions is presented. Some observations on the real and imaginary potentials of very heavy ions are presented. (AIP)

12022 **Recoil studies of nuclear reactions induced by high-energy particles. II. Production of ^{149}Tb by 1- to 300-GeV protons on ^{197}Au.** Winsberg, L.; Weisfield, M.W.; Henderson, D. (Department of Physics, University of Illinois at Chicago Circle, Chicago, Illinois). *Phys. Rev., C;* 13: No. 1, 279-282(Jan 1976).

The fraction of ^{149}Tb activity recoiling out of a gold target into the forward (F) and backward (B) directions was determined in irradiations with protons of 1, 3, 11.5, and 300 GeV. The values of F/B decreased from 9.6 at 1 GeV to 2.4 at 300 GeV. The values of 2W (F+B) decreased from 1.24 mg of Au per cm^2 at 1 GeV to 0.89 mg of Au per cm^2 at 300 GeV, where W is the thickness of the gold target. These results were analyzed in terms of the standard two-step model for the reaction. The momentum transfer, which occurs in the first step, decreases with the energy of the incident protons. The average kinetic energy of the ^{149}Tb nuclei in the second step is 3.9+-0.1 MeV for protons in the energy range from 0.7 GeV (earlier work) to 300 GeV. The constancy of this value indicates that the reaction mechanism is essentially unchanged over this range of bombarding energies. (AIP)

12023 Photoneutron polarization studies of the giant M1 resonance in ^{208}Pb. Holt, R.J.; Jackson, H.E. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.*; **36**: No. 5, 244-248(2 Feb 1976).

The photoneutron polarization from states near threshold was measured, for the first time, for the reaction ^{208}Pb(γ,n_0)^{207}Pb throughout the neutron energy range 500 to 1000 keV. Spin and parity assignments were made for these states. The giant M1 resonance in ^{208}Pb was found to be less fragmented than previously thought. The data suggest that there is some "missing" M1 strength in ^{208}Pb. (AIP)

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 12004

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

RADIOACTIVE DECAY

12024 Theoretical estimates of spontaneous-fission half-lives for superheavy elements based on the modified-oscillator model. Randrup, J. (Univ. of California, Berkeley); Larsson, S.E.; Moeller, P.; Sobiczewski, A.; Lukasiak, A. *Phys. Scr.*; **10A**: 60-64(1974).

From 20. Nobel symposium; Ronneby, Sweden (11 Jun 1974).

The stability problem for the superheavy elements has been reconsidered based on the use of the shape-dependent droplet model and the modified-oscillator potential. The effect of axial asymmetry on the barrier heights is included. A semi-empirical inertial-mass function is employed. Alternatively the inertial-mass parameters are calculated microscopically. The spontaneous-fission half-lives are calculated with these inertias. Both of the latter were renormalized to give optimal agreement with experimental half-lives in the actinide region. The resulting spontaneous-fission half-lives in the SHE region are somewhat shorter than those of most previous estimates, predicting, for example, around 10^5 years as the total half-life for the most stable nucleus ^{294}110. 8 figures, 1 table. (auth)

NUCLEAR REACTIONS AND SCATTERING

12025 (JUL-Conf—16(Vol.1), pp 24) **Hadronic excitation of the giant resonance region of ^{208}Pb.** Halbert, E.C. (Oak Ridge National Lab., TN); McGrory, J.B.; Satchler, G.R.; Speth, J. Jul 1975.

From Conference on highly excited states of nuclei; Julich, F.R. Germany (22 Sep 1975).

In International symposium on highly excited states in nuclei, Juelich, 23—26 September 1975. Volume 1.

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 12071

12026 Preliminary study of additional effects with bearing on the barrier heights for superheavy elements. Larsson, S.E. (Lund Inst. of Tech., Sweden); Leander, G.; Ragnarsson, I.; Randrup, J. *Phys. Scr.*; **10A**: 65-70(1974).

From 20. Nobel symposium; Ronneby, Sweden (11 Jun 1974).

The effects of the simultaneous presence of monopole and quadrupole pairing interactions on the fission barriers for heavy and superheavy elements are considered. The first barrier for light Th isotopes is found to be raised by 1 MeV, while heavier actinide nuclei seem to be less affected by the inclusion of quadrupole pairing. For the superheavy elements, the inclusion of quadrupole pairing tends to increase the barriers considerably. Moreover, the Coulomb energy, associated with the non-homogeneous charge distribution of the modified oscillator model, is compared with the liquid-drop value and with the value emerging from a self-consistent calculation based on the Skyrme interaction. The shell effect, which may be several MeV in magnitude, appears to be highly sensitive to model assumptions concerning the forces between neutrons and protons. 7 figures. (auth)

12027 Spontaneous-fission half-lives for even nuclei with Z> or =92. Randrup, J.; Larsson, S.E.; Moller, P.; Nilsson, S.G.; Pomorski, K.; Sobiczewski, A. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., C*; **13**: No. 1, 229-239(Jan 1976).

The spontaneous-fission process for doubly even nuclei with Z> or =92 is studied in a semiempirical WKB framework. One-dimensional fission barrier potentials are established from theoretical deformation-energy surfaces based on the droplet model and the modified-oscillator model. The effects of axial asymmetry as well as reflection asymmetry have been taken into account. Macroscopic (irrotational flow) inertial-mass functions and, alternatively, microscopic (cranking model) inertial mass parameters have been employed for the calculation of the fission half-lives. With one over-all normalization parameter it is possible to fit the experimental half-lives to within a factor of 20 on the average. The resulting effective inertial-mass functions are used to estimate the stability of the transactinide elements. Only minor differences with previous estimates for the r process and superheavy nuclei are encountered. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 12039

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 12007, 12033

12028 Collective excitations in ^{246}Cm and the decay of ^{246}Am/subm/. Multhauf, L.G.; Tirsell, K.G.; Meyer, R.A. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., C*; **13**: No. 2, 771-789(Feb 1976).

Intense sources of ^{246}Pu have been produced (through double neutron capture by ^{244}Pu) for making detailed electromagnetic and conversion-electron measurements of the decay of ^{246}Am/subm/ to levels of ^{246}Cm. γ rays from ^{246}Pu decaying to ^{246}Am levels were identified in a chemical milking experiment. Of the 260 ^{246}Cm γ rays observed, 97 are new and 64 have been assigned multipolarities from Si (Li) conversion-electron measurements. Some transitions were found to have strong E0 components, and two pure E0 transitions were observed. High-resolution γ-γ—time coincidence measurements were used to establish 54 levels, from which the low-energy band structure of ^{246}Cm was determined. The investigation confirmed previous assignments of K/sup pi/=0^-, 1^-, and 2^- octupole bands, and a K/sup pi/=0^+ band at 1175 keV. We have also identified the probable K/sup pi/=3^- octupole band, and a second K/sup pi/=0^+ band at 1289 keV. The two K/sup pi/=0^+ bands are discussed in terms of possible collective excitations. Other identified bands are discussed in terms of two-quasiparticle and multipole-phonon excitations. (AIP)

12029 Nuclear data sheets for A = 220. Ellis, Y.A. (Oak Ridge National Lab., TN). *Nucl. Data Sheets;* **17**: No. 3, 341-350(Mar 1976).

Nuclear structure information for all nuclei with mass number A = 220 is summarized. Evaluated data and the adopted levels and spin and parity assignments are given. Level scheme information for all nuclei is from α-decays of their parents with A = 224. α-parents are shown on the drawings above their daughters. α-decay data are given as much as possible on the drawings. Unless otherwise indicated, γ-transition (photon + ce) intensities are shown. For data with uncertainties and references, see A = 224 compilation in this issue. (auth)

12030 Nuclear data sheets for A = 224. Ellis, Y.A. (Oak Ridge National Lab., TN). *Nucl. Data Sheets;* **17**: No. 3, 351-366(Mar 1976).

Nuclear structure information for all nuclei with mass number A = 224 is summarized. Evaluated data and the adopted levels and spin and parity assignments are given. Data for ^{224}Rn and ^{224}Fr β-decays and ^{224}Fr decay schemes are from unpublished work by V. P. Afanesev, et al. (1973), and should be considered preliminary. ^{224}Ac epsilon-decay data and decay scheme are from unpublished work by M. W. Hill (1958), who used NaI crystal to detect photons. A complete, more reliable decay work would be desirable, and would be useful to determine the ^{224}Ac ground-state spin. α-parents are shown on the drawings above their daughters. α-decay data are given as much as possible on the drawings. Unless otherwise indicated, γ-transitions (photon + ce) intensities are shown. For data with uncertainties and references, see A = 228 compilation in this issue. (auth)

12031 Nuclear data sheets for A = 228. Horen, D.J. (Oak Ridge National Lab., TN). *Nucl. Data Sheets;* 17: No. 3, 367-390(Mar 1976).

The experimental data for nuclei in the mass chain A = 228 have been examined, and the results summarized. Where possible, the results are presented in pictorial form. The text contains tables of adopted levels and properties, tables of radiations, comments which point out deficiencies or inconsistencies in the data, and a reference list. For those cases where only tentative or partial decay schemes are given, the reader is encouraged to contact the compiler for more specific detail. Structure information is relatively sparse except for the ^{228}Th nucleus. Except where noted, Q-values have been adopted from 74WaBG. Data for the decay of the ground states of the A = 232 isotopes have been taken from 70Sc37 since there has been little modification except for the half-life of ^{232}Pu (see 73Ja06) and alpha decay of ^{232}U (see 71So15) and 72Go33). Data on the alpha decay of A = 228 nuclei have been taken from the compilation for A = 224 (this issue) by Y. A. Ellis. In the drawings, transition intensities per 100 decays of the parent are given. The compilation has been prepared by computer from data sets entered by the compilers into the Evaluated Nuclear Structure Data File (ENSDF). Corrections or additions to the content of this compilation should be addressed to the compiler for inclusion in the ENSDF. (auth)

12032 Nuclear data sheets for (even-A) A = 244 through A = 262. Schmorak, M.R. (Oak Ridge National Lab., TN). *Nucl. Data Sheets;* 17: No. 3, 391-484(Mar 1976).

The available experimental data pertaining to the nuclear structure of nuclei with even mass numbers A equals 244 through 262 are compiled (the odd-A mass chains will be published in 1976). The results from various decay and reaction measurements, as available through September 1975, are compared and evaluated and α-hindrance factors are calculated. (auth)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 12021, 12042

12033 (TID—26950) Recoil-distance lifetime measurements and multiple Coulomb excitation studies of ^{232}U. Guidry, M.W. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. 201p. Dep. NTIS $7.75.

Thesis submitted to Univ. of Tennessee.

Recoil-distance lifetime measurements and multiple Coulomb excitation studies have been performed for the 4^+, 6^+, 8^+, 10^+, and 12^+ members of the ^{232}U ground-state rotational band. The recoil-distance data were analyzed with a theoretical correction procedure that was developed during the course of this work and implemented in a computer code ORACLE. The half-lives determined by the recoil-distance technique were 124.0 +- 7.3 ps (4^+), 58.2 +- 3.3 ps (6^+), 23.9 +- 1.9 ps (8^+), 11.6 +- 1.1 ps (10^+), and 5.5 +- 2.2 ps (12^+). These correspond to B(E2, I/sub i/ yields I/sub i/ -2)/e^2b^2 values of 3.03 +- 0.20 (4^+), 3.28 +- 0.19 (6^+), 3.42 +- 0.28 (8^+), 3.11 +- 0.30 (10^+), and 3.34 +- e^2b^2. 3 12 '). Transition quadrupole moments Q_0(I/sub i/ yields I/sub f/) extracted from the B(E2) values are constant within experimental error and support the interpretation of ^{232}U as a good rotor for I/supπ/ less than or equal to 12^+. The comparison of multiple Coulomb excitation probabilities with those predicted by theory has confirmed the sign of the E4 moment in ^{232}U as positive. This is in agreement with theoretical predictions and resolves a previous ambiguity in the sign of the moment as determined by alpha-particle Coulomb excitation. The success of this work has demonstrated that recoil-distance measurements and multiple Coulomb excitation are important complementary techniques in the study of high-spin rotational states. 36 figures, 10 tables, 99 references. (auth)

12034 Time-of-flight neutron spectroscopy using approximately 20 meter flight paths to a nuclear device. Forman, L.; Silbert, M.G.; Scheiberg, A.D. (Los Alamos Scientific Lab., N.Mex. (USA)). *Nucl. Instrum. Methods;* 128: No. 3, 607-608(15 Oct 1975).

Time-of-flight neutron spectroscopy is described using relativity short flight paths to nuclear explosives. Neutron fluxes have been determined from ^{235}U and ^{238}U fission with solid state detectors in the direct current mode. A demonstration gamma-ray production cross section experiment for ^{241}Am has yielded data over the neutron energy range 0.3—6.0 MeV. (NL)

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 12034

12035 (ANL/NDM—18) Delayed neutron yield of ^{238}U and ^{241}Pu. Meadows, J.W. (Argonne National Lab., Ill. (USA)). Jan 1976. 24p. Dep. NTIS $3.50.

The total delayed neutron yield for ^{238}U and ^{241}Pu were observed as a function of the incident neutron energy. The measurements extend from 2.5 to 5 MeV for ^{238}U and from 0.15 to 5 MeV for ^{241}Pu. The average ratio of the ^{241}Pu delayed neutron yield to that of ^{238}U is 0.292 +- 0.022.

12036 Superheavies in nature: where and how to look. Nurmia, M. (Univ. of California, Berkeley). *Phys. Scr.;* 10A: 77-80(1974).

From 20. Nobel symposium; Ronneby, Sweden (11 Jun 1974).

In searching for superheavy elements in nature it is usually assumed that the SHE (1) follows the chemistry of its lighter homolog and (2) decays by spontaneous fission. The sensitivity of SHE detection can be substantially improved by replacing these assumptions by a consideration of the geochemical fractionation processes, and by using a mass spectrometer. A good candidate for a search would be element 112, eka-mercury. It is expected to be more volatile and more noble than Hg so that it may behave like a heavy rare gas and be concentrated in the earth's atmosphere. 5 tables, 2 figures. (auth)

12037 Resonance region analysis without resonance parameters. Pearlstein, S. (Brookhaven National Lab., Upton, NY). *Nucl. Sci. Eng.;* 58: No. 4, 354-360(Dec 1975).

A representation for structured data is described that does not make use of a resonance parameter formalism and is applicable in a region where resonance parameters cannot be resolved or in a resolved resonance region where the precise location of a resonance is unimportant. Following the Probability Table Method, a representation statistically equivalent to a pointwise description of data is given but extended to characterize energy correlations. In the case of data from which higher order derivatives can be taken, a method for temperature broadening and unbroadening data is presented. 7 figures. (auth)

12038 Fission cross section of ^{238}U from 0.8 to 4 MeV. Czirr, J.B.; Sidhu, G.S. (Univ. of California, Livermore). *Nucl. Sci. Eng.;* 58: No. 4, 371-376(Dec 1975).

The relative energy dependence of the ^{238}U fission cross section has been measured with respect to the (n, p) scattering reaction for neutron energies from 0.8 to 4 MeV. The Lawrence Livermore Laboratory Linac provided a pulsed source of neutrons, and energies were measured by neutron time of flight. The flux monitor consisted of a thin annular polyethylene proton radiator with a shielded recoil detector. The total error in the relative ^{238}U(n, f) cross section is less than 1.5 percent from 0.8 to 4 MeV. 5 figures, 1 table. (auth)

12039 How to detect the heaviest man-made isotopes. Meldner, H.W.; Cowan, G.A.; Nix, J.R.; Stoughton, R.W. (University of California at San Diego, La Jolla, California 92037). *Phys. Rev., C;* 13: No. 1, 182-188(Jan 1976).

The average number of neutrons emitted per spontaneous fission is predicted to increase substantially for very heavy nuclei. This suggests the use of neutron-multiplicity counters for the early detection of heavy isotopes produced by prompt neutron capture. We discuss the possibilities and limitations of such a technique. (AIP)

12040 Mass and kinetic energy measurements of fragments from the isomeric and excited state fission of ^{242}Am. Weber, J.; Erdal, B.R.; Gavron, A.; Wilhelmy, J.B. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev., C;* 13: No. 1, 189-194(Jan 1976).

Coincident fission fragment kinetic energies were measured for the isomeric and excited state fission of ^{242}Am. The fission isomer was produced using the ^{240}Pu(t, 3n)^{242}Am/supm/ reaction, while the excited state fission was studied using the ^{241}Am(d, pf) direct reaction. The fission distributions were found to be very similar but significant deviations do occur. The isomeric average total kinetic energy is 2 MeV higher than the excited state fission (4.4 < or = E/subx/ < or = 11.5 MeV) of ^{242}Am and the isomer has a lower yield for symmetric division. The mass distributions are qualitatively consistent with the isomer's being more strongly influenced by the asymmetric outer fission barrier. (AIP)

12041 Prompt fission neutrons from eV resonances in ^{235}U: Measurement and correlation with other fission properties. Howe, R.E.; Phillips, T.W.; Bowman, C.D. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., C;* 13: No. 1, 195-205(Jan 1976).

The energy dependence of the fission neutron multiplicity nu-bar for neutron-induced fission of ^{235}U in the energy region 0.5 to 125 eV has been measured using a continuous spectrum of

neutrons from a 100 MeV electron Linac. A new neutron detection technique was used to search for variations in resonance nu-bar values and possible correlations with other fission properties. Evidence was obtained for a nonstatistical fluctuation in the value of nu-bar as a function of energy. However, no correlation with resonant spin, Γ/sub f/, fission-fragment asymmetry, or the angular distribution of fission fragments was observed. A comparison of these data with previous nu-bar measurements also has been included. (AIP)

12042 **Energy dependence of quasifission.** Tamain, B.; Plasil, F.; Ngo, C.; Peter, J.; Berlanger, M.; Hanappe, F. (Chimie Nucleaire, Institut de Physique Nucleaire, 91406 Orsay, France). *Phys. Rev. Lett.*; **36**: No. 1, 18-21(5 Jan 1976).

Quasifission reactions induced by 443-MeV ^{65}Cu ions on ^{197}Au are studied and compared with results at 365 MeV. The initial relative motion is completely damped in both cases. At the higher energy, the angular distribution is broader and peaked further forward, and the complete-fusion component is larger. Near the grazing angle partially damped events are observed in addition to quasifission. (AIP)

12043 **Measurement of the neutron capture and fission cross sections of ^{239}Pu and ^{235}U, 0.02 eV to 200 keV, the neutron capture cross sections of ^{197}Au, 10 to 50 keV, and neutron fission cross sections of ^{233}U, 5 to 200 keV.** Gwin, R.; Silver, E.G.; Ingle, R.W.; Weaver, H. (Oak Ridge National Lab., TN). *Nucl. Sci. Eng.*; **59**: No. 2, 79-105(Feb 1976).

The neutron absorption and fission cross sections for ^{239}Pu and ^{235}U have been measured over the neutron energy range from 0.02 eV to 200 keV. In addition, the neutron capture cross section for ^{197}Au was measured from 10 to 50 keV and the fission cross section of ^{233}U was measured from 0.1 to 100 keV. Normalization of the ^{239}Pu and ^{235}U data was made over the energy region from 0.02 to 0.4 eV to the ENDF/B-III neutron cross sections for these isotopes, Mat 1159 and 1157, respectively. The capture cross section for ^{197}Au was normalized using the saturated resonance method for the 4.9-eV resonance. For ^{235}U fission, the normalization was made using the results of Weston et al. The neutron flux was measured using the ^{10}B(n,α) reaction; the energy variation used for this reaction was that given in ENDF/B-III. The pulsed-neutron beam for these measurements was generated using the Oak Ridge Electron Linear Accelerator. A large liquid scintillator about 40 m from the neutron source was used to detect the prompt gamma-ray cascades resulting from neutron absorption in the sample. In general for ^{239}Pu and ^{235}U, these experiments indicated lower neutron fission cross sections than contained in ENDF/B-III for energies above 10 keV. The measured values of the ratio α, neutron capture-to-neutron fission, for ^{239}Pu agree within errors with those derived from ENDF/B-III, Mat 1159. For the present measurements, the uncertainty on α for ^{239}Pu is approximately 11 percent at 10 keV and increases to approximately 30 percent at 100 keV. The experimental results for the neutron capture cross section for ^{197}Au are approximately 15 percent lower than the ENDF/B-III values. The measurements of the ratio of the neutron fission cross section for ^{235}U to that for ^{238}U are generally higher than the ENDF/B-III values by approximately 5 percent. 15 tables, 11 figures. (auth)

NUCLEAR THEORY

REFER ALSO TO CITATION(S) 11911

NUCLEAR STRUCTURE

REFER ALSO TO CITATION(S) 12063

12044 (JUL-Conf—16(Vol.1), pp 30) **Validity of several many-body methods in the backbending region.** Ring, P.; Chu, S.Y.; Marshalek, E.R. (Univ. of California, Berkeley). Jul 1975.

From Conference on highly excited states of nuclei; Julich, F.R. Germany (22 Sep 1975).

In International symposium on highly excited states in nuclei, Juelich, 23—26 September 1975. Volume 1.

NUCLEAR MATTER

REFER ALSO TO CITATION(S) 11821

12045 (BNL—50445, pp 1-12) **Possible new form of matter at high density.** Lee, T.D. (Columbia Univ., New York). 1974.

From BeV;nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In Report of the workshop on GeV/nucleon collisions of heavy ions: how and why.

As a preliminary to discussion of the possibility of new forms of matter at high density, questions relating to the vacuum and vacuum excitation are considered. A quasi-classical approach to the development of abnormal nuclear states is undertaken using a Fermi gas of nucleons of uniform density. Discontinuous transitions are considered in the sigma model (tree approximation) followed by brief consideration of higher order loop diagrams. Production and detection of abnormal nuclear states are discussed in the context of high energy heavy ion collisions. Remarks are made on motivation for such research. 8 figures. (SDF)

12046 (BNL—50445, pp 18-33) **Pion condensates.** Brown, G.E. (NORDITA, Copenhagen). 1974.

From BeV;nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In Report of the workshop on GeV/nucleon collisions of heavy ions: how and why.

A study is made of pion condensation based on the neutron matter analysis of Sawyer and Scalapino. The formalism is first discussed, followed by examination of short-range nucleon-nucleon correlations, the s wave pion-nucleon interaction, and nucleon self-energies. The role of isobars in bringing the pion condensate down to low densities is detailed. 10 figures, 2 tables. (SDF)

12047 (BNL—50445, pp 34-35) **Comments on charged pion condensation in dense matter.** Baym, G. (Univ. of Illinois, Urbana). 1974.

From BeV;nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In Report of the workshop on GeV/nucleon collisions of heavy ions: how and why.

Comments are offered on the physics of the instability leading to pion condensation and the condensed state is briefly discussed. (SDF)

12048 (BNL—50445, pp 36-38) **Nuclear matter calculations of finite and infinite nuclear systems from relativistic field theory.** Kerman, A.K. (Massachusetts Inst. of Tech., Cambridge). 1974.

From BeV;nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In Report of the workshop on GeV/nucleon collisions of heavy ions: how and why.

A new direction for the calculation of nuclear properties with current knowledge of finite nuclei is briefly discussed. Main emphasis is on developing a framework in which the meson field can be made self-consistent. Three types of worthwhile experiments are suggested. 1 figure. (SDF)

12049 (BNL—50445, pp 39-47) **Possibility of nuclear shock waves in relativistic heavy ion collisions.** Hofmann, J.; Stoecker, H.; Scheid, W.; Greiner, W. (Univ., Frankfurt am Main). 1974.

From BeV;nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In Report of the workshop on GeV/nucleon collisions of heavy ions: how and why.

Using a hydrodynamic model, the possibility of compression of nuclear matter in colliding nuclei is considered. A model suggesting the formation of ($^3/_2$, $^3/_2$)resonances and higher nuclear states as a consequence of thermal excitation of nucleons during the collision process is extended to include higher mass resonances. Their effect on the compression is examined. 1 table, 4 figures (SDF)

12050 (BNL—50445, pp 48-49) **Shock waves in colliding nuclei.** Siemens, P.J. (The Niels Bohr Inst., Copenhagen). 1974.

From BeV;nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In Report of the workshop on GeV/nucleon collisions of heavy ions: how and why.

The circumstances under which matter at high densities can be produced in heavy-ion collisions is considered. It is argued that laboratory energies of a few hundred MeV per nucleon will be suitable: the matter velocity will exceed the speed of sound, while the nuclear matter has sufficient stopping power to generate a shock front. (auth)

12051 (BNL—50445, pp 52-58) **Astrophysical implications of pion condensation.** Sawyer, R.F. (Univ. of California, Santa Barbara). 1974.

From BeV;nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In Report of the workshop on GeV/nucleon collisions of heavy ions: how and why.

Consequences for neutron star structure of forms of abnormal nuclear matter and pion condensation effects are studied using

different equations of state for neutron star matter. Pressure as a function of energy density and mass-radius relations are plotted. 7 figures (SDF)

12052 (BNL—50445, pp 67-70) **Search for ultradense nuclei in collisions of GeV/nucleon Ar + Pb.** Price, P.B. (Univ. of California, Berkeley). 1974.

From BeV;nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In Report of the workshop on GeV/nucleon collisions of heavy ions: how and why.

The task of creating abnormal nuclear states is divided into two phases. First, the Bevalac is used to determine the optimum conditions for attaching high-energy heavy projectiles to heavy target nuclei, using Lexan plastic track detectors to identify heavy recoils ejected along the beam direction. Second, some property of such high-Z products that would indicate whether some of them could be stable ultradense nuclei are measured. (auth)

12053 **Search for stable, abnormal (collapsed) nuclei in nature.** Holt, R.J.; Schiffer, J.P.; Specht, J.; Bollinger, L.M.; Thomas, G.E.; Fried, S.M.; Hines, J.J.; Friedman, A.M. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.*; **36**: No. 4, 183-186(26 Jan 1976).

Very tightly bound, abnormally-high-density states of nuclei, suggested as a possibility by Bodmer and by Lee and Wick, have been searched for as an anomalous isotope of radon. This was done by looking for high-energy γ rays following thermal-neutron capture. The limit that may by set for the atomic concentration of such nuclides on Earth is $\sim 10^{-39}$ atom of Si. (AIP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 11848, 11905, 12021, 12049, 12050

12054 (BNL—50445) **Report of the workshop on GeV/nucleon collisions of heavy ions: how and why, November 29—December 1, 1974, Bear Mountain, New York.** (Brookhaven National Lab., Upton, N.Y. (USA)). 1974. 91p. (CONF-741152—). Dep. NTIS $7.25.

From BeV;nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

Abstracts for 13 papers appear separately in NSA and ERA. (SDF)

12055 (BNL—50445, pp 14-17) **Current knowledge of the interactions of relativistic heavy ions.** Heckman, H.H. (Univ. of California, Berkeley). 1974.

From BeV;nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

In Report of the workshop on GeV/nucleon collisions of heavy ions: how and why.

Some experimental results that have given some key information on the interactions of relativistic heavy ions are reviewed. Topics are (1) the nucleus-nucleus interaction in nuclear track emulsions, (2) target fragmentation studies, (3) particle production in heavy-ion collisions, and (4) fragmentation of relativistic ^{12}C and ^{16}O nuclei. 1 table (auth)

12056 (COO—3463-23) **Neutron and gamma emission from highly excited states and states with high spin. Annual progress report.** Sperber, D. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA)). Aug 1975. Contract E(11-1)-3463. 13p. Dep. NTIS $4.50.

During the last year attention was focused on the theoretical study of heavy ion induced reactions at low and intermediate energy with particular attention on very heavy projectiles. Most of the studies described have been finished, others are under current investigation. In most of the calculations, a classical dynamical approach was adopted, others concern themselves with assessing the validity of this classical approximation. In all calculations, one addressed oneself to the evaluation of quantities which are measured experimentally. Examples of such quantities are the critical angular momentum for complete fusion, the angular distribution for deep inelastic processes, and mass and energy transfer. The following topics have been investigated during the recent phase of this program: (1) The development of a classical dynamical model for the study of heavy ion reactions. (2) The calculation of the critical angular momentum using the proximity potential. (3) The role of potential and friction in heavy ion reactions. (4) Angular distribution for Kr induced reactions. (5) The validity of the sharp cut-off approximation. (6) The difference between Argon and Krypton induced reactions leading to the same compound nucleus. (7) Statistical studies of mass transfer. (8) The inclusion of the necking degree of freedom. (9) Semiclassical calculation. The results of the studies of the first seven topics are already available in the open literature. The last two topics are under current investigation. (auth)

12057 (ORNL-TM—5000) **Selected topics in heavy-ion reactions.** Wong, C.Y. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 101p. Dep. NTIS $5.45.

A few selected topics in heavy ion reactions are examined. Three aspects specifically addressed are (1) phase transitions of the nuclear fluid, (2) speculations concerning abnormal matter, and (3) nuclei with exotic shapes. The discussion bases on a fluid dynamical description of the reaction process. 42 figures, 1 table, 68 ref. (SDF)

12058 **Nuclear collisions with friction.** Tsang, C.F. (Univ. of California, Berkeley). *Phys. Scr.*; **10A**: 90-93(1974).

From 20. Nobel symposium; Ronneby, Sweden (11 Jun 1974).

A theory of nuclear collisions where a frictional force is introduced explicitly from the beginning is worked out based on a macroscopic and leptodermous idealization. A solution of the problem is made by freezing all degrees of freedom but four: the distance between centers of the colliding nuclei, the angle of rotation of a line joining the centers and the two angles measuring the spins of the nuclei. The condition for capture as a function of energy and angular momentum is discussed in detail. Results on the kinetic energy and angular distributions of collision products are also obtained. 5 figures. (auth)

12059 **Stability of element in the r-process region.** Bengtsson, R. (Lund Inst. of Tech., Sweden); Boleu, R.; Larsson, S.E.; Randrup, J. *Phys. Scr.*; **10A**: 142-148(1974).

From 20. Nobel symposium; Ronneby, Sweden (11 Jun 1974).

The fission barriers of the nuclei in the r-process region have been calculated with inclusion of axial asymmetry and reflection asymmetry. Neutron separation energies and spontaneous-fission half-lives have been calculated and the possibilities of producing superheavy elements by means of neutron-capture processes are discussed. 12 figures. (auth)

12060 **Role of potential and friction in the dynamics of heavy ion reactions.** Sperber, D. (Rensselaer Polytechnic Inst., Troy, NY). *Nukleonika;* **20**: No. 7-8, 755-774(1975).

A classical theory with dissipative forces is used to analyze the reactions between heavy ions high above the Coulomb barrier. The importance of the interplay between the conservative nuclear potential and dissipative forces is discussed. It is demonstrated that a dynamical theory with dissipative forces is very useful for the interpretation of the experimental results. (auth)

12061 **Knock-out processes and removal energies.** Dieperink, A.E.L.; de Forest, T. Jr. (Inst. for Nuclear Physics Research, Amsterdam). *Annu. Rev. Nucl. Sci.*; **25**: 1-26(1975).

A derivation is given of the cross section for knock-out reactions, treating (e, e'N) as an example. Since the basic nuclear structure information is contained in the spectral function; a brief treatment is given of the spectral function in the independent particle model. The question of how one can relate the energy dependence of the spectral function to the results of microscopic nuclear structure theories is considered in terms of occupation probabilities and mean removal energies. Higher moments of the spectral function characterizing such processes as fragmentation are discussed. 6 figures, 1 table, 51 references. (SDF)

12062 **Preequilibrium decay.** Blann, M. (Univ. of Rochester, NY). *Annu. Rev. Nucl. Sci.*; **25**: 123-166(1975).

After a description of the properties of particle spectra attributable to preequilibrium (PE) decay, a discussion is presented of models which have been applied in support of these characteristics as due to decay of states during the equilibration process. Specific models included are the cascade model, the Harp—Miller—Berne model, the exciton model, the hybrid and geometry-dependent hybrid models, and phase space approaches to PE decay. A brief summary of areas of application of PE is given along with speculation as to probable future directions. 22 figures, 2 tables, 107 references (SDF)

12063 **Electron scattering and nuclear structure.** Donnelly, T.W.; Walecka, J.D. (Stanford Univ., CA). *Annu. Rev. Nucl. Sci.*; **25**: 329-405(1975).

Electron scattering is treated within the framework of the one-photon exchange approximation. Electron excitation of collective particle-hole states (including the giant dipole resonance) is detailed. The process of quasi-elastic scattering is then discussed within the framework of the Fermi gas model. A brief review is presented of the relationship between electromagnetic interactions and semileptonic weak interactions, stressing the extra knowledge that the electron scattering yields. Finally, a few special topics of

interest in intermediate energy physics are examined. 221 references. (SDF)

12064 Inelastic shadowing effects in multiple scattering. Londergan, J.T.; Moniz, E.J. (Department of Physics, Indiana University, Bloomington, Indiana 47401). *Ann. Phys. (N.Y.);* **94**: No. 1, 83-127(19 Sep 1975).

The projectile—nucleon scattering amplitudes used as input into multiple scattering theories of projectile—nucleus scattering naturally include the effects of coupling to inelastic (i.e., production) channels. We employ a multichannel separable potential to describe the projectile—nucleon interaction and show that within the fixed nucleon framework we can obtain the nuclear elastic scattering amplitude. This includes terms outside the conventional formalisms, corresponding to intermediate propagation in the inelastic channels both above and below inelastic threshold. We refer to this as inelastic shadowing. In a two-channel approximation, we show that knowledge of the projectile—nucleon elastic scattering phase shifts plus specification of the inelastic threshold energy are sufficient to determine the off-shell coupled-channel transition matrix, implying that the nuclear amplitude can be calculated within this model without any detailed information about the inelastic channels. We study this solution quantitatively for some model problems and for pion scattering, with the general result that inelastic shadowing can be significant whenever the elementary interaction has important channel coupling. For pion scattering in the energy regime characterized by strongly absorptive resonance, we find, for example, that the effect of inelastic shadowing is much more important than that due to two-nucleon correlations. (AIP)

12065 Hadron—nucleus collisions at high energies. Koplik, J.; Mueller, A.H. (Department of Physics, Columbia University, New York, New York 10027). *Phys. Rev., D;* **12**: No. 11, 3638-3665(1 Dec 1975).

We discuss high-energy hadron—nucleus scattering in terms of models in which the basic hadron—hadron interaction is due to the exchange of Regge poles and cuts. Much of the paper uses a configuration-space description in which the time scales of interactions are of critical importance, although equivalent results may be obtained in momentum space. We study in detail the general behavior of elastic, total, and inclusive cross sections, the relevance of the Glauber expansion, and the influence of Regge cuts and interactions. Most of the discussion is based on the softened-field-theory model of Reggeons, although we also consider the contrasting planar dual string model and show how one may experimentally distinguish between models of these two types. (AIP)

12066 Some effects of particle identity in many-body scattering using the method of channel coupling arrays. Kouri, D.J.; Levin, F.S. (Chemistry Department, University of Houston, Houston, Texas 77004). *Phys. Rev., C;* **13**: No. 1, 14-19(Jan 1976).

Scattering events of the type a + A yields A + a, where A is composed of (n - 1) particles all identical to a, are studied within the framework of the channel coupling array approach to many-body scattering. The n coupled equations describing the scattering derived under the assumption that the n particles forming the scattering system are distinguishable are shown to collapse to a single equation when particle identity is taken into account, and a particular choice of a channel coupling array which includes the important special case of channel permuting arrays is made. For this latter choice, which guarantees connectedness, only the exchange Born potential explicitly enters the integral equation for the transition operator or the differential equation for the scattering function. The present derivation provides a justification of equations used previously in $e^- + H$ calculations. (AIP)

12067 Localization in heavy-ion elastic, inelastic, and transfer reactions. Moffa, P.J.; Dover, C.B.; Vary, J.P. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., C;* **13**: No. 1, 147-155(Jan 1976).

A quantitative technique for studying the localization of heavy-ion reactions in both coordinate (r) and angular momentum (L) space has been developed. A comparison of the degree of localization in elastic, inelastic, and one-particle transfer reactions is presented. For elastic scattering, the localization is studied as a function of the angular range of the data. A fully quantum mechanical relationship between L and r is demonstrated. (AIP)

12068 Optical potentials derived from microscopic separable interactions including binding and recoil effects. Siciliano, E.R.; Walker, G.E. (Department of Physics, Indiana University, Bloomington, Indiana 47401). *Phys. Rev., C;* **13**: No. 1, 257-278(Jan 1976).

We first consider a projectile scattering from a nucleon bound in a fixed potential. A separable Galilean invariant projectile-nucleon interaction is adopted. Without using the fixed scatterer approximation or using closure on the intermediate target nucleon states we obtain various forms for the projectile-bound nucleon t matrix. Effects due to intermediate target excitation and nucleon recoil are discussed. By making the further approximations of closure and fixed scatterers we make connection with the work of previous authors. By generalizing to projectile interaction with several bound nucleons and examining the appropriate multiple scattering series we identify the optical potential for projectile elastic scattering from the many-body system. Different optical potentials are obtained for different projectile-bound nucleon t matrices, and we study the differences predicted by these dissimilar optical potentials for elastic scattering. In a model problem, we study pion-nucleus elastic scattering and compare the predictions obtained by adopting procedures used by (1) Landau, Phatak, and Tabakin and (2) Piepho-Walker to the predictions obtained in a less restrictive, but computationally difficult treatment. (AIP)

12069 Invariant potential for elastic pion—nucleus scattering. Cammarata, J.B.; Banerjee, M.K. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Phys. Rev., C;* **13**: No. 1, 299-314(Jan 1976).

From the Wick-Dyson expansion of the exact propagator of a pion in the presence of a nucleus, an invariant potential for crossing symmetric elastic pion-nucleus scattering is obtained in terms of a series of pion-nucleon diagrams. The Chew-Low theory is used to develop a model in which the most important class of diagrams is effectively summed. Included in this model is the exclusion principle restriction on the pion-bound nucleon interaction, the effects of the binding of nucleons, a kinematic transformation of energy from the lab to the πN center of mass frame, and the Fermi motion and recoil of the target nucleons. From a numerical study of the effects of these processes on the π-^{12}C total cross section, the relative importance of each is determined. Other processes contributing to the elastic scattering of pions not included in the present model are also discussed. (AIP)

12070 Unitarity relation for the optical potential. Ernst, D.J.; Thaler, R.M. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). *Phys. Rev. Lett.;* **36**: No. 4, 222-224(26 Jan 1976).

It is shown that the impulse approximation of Watson satisfies many-body unitarity to within terms which represent scattering from two different target particles. A systematic development further defines the nth-order optical potential such that unitarity is satisfied to within scattering from n+1 different target nucleons. (AIP)

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 12059

12071 Microscopic calculation of nuclear dissipation. Koonin, S.E.; Nix, J.R. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., C;* **13**: No. 1, 209-228(Jan 1976).

By use of a time-dependent wave function of the BCS form, we compute microscopically the energy dissipated for a system with a monopole pairing force moving under the influence of a time-dependent single-particle potential. Quasiparticle generation and coupling of the two-quasiparticle modes of the system are included automatically and provide contact with the Landau-Zener formula. The single-particle potential is related to nuclear shapes generated by viscous hydrodynamical calculations of a fissioning ^{236}U nucleus. We attempt to determine the energy dissipated between the saddle point and scission point by requiring that at the scission point the energy dissipated in the microscopic calculations equal that dissipated in the macroscopic hydrodynamical calculations. This procedure leads to 34 MeV of dissipated energy, which is almost twice the value of 18 MeV obtained from macroscopic hydrodynamical calculations that reproduce experimental fission-fragment kinetic energies. The corresponding value of the nuclear viscosity coefficient determined from the microscopic calculations is 0.04 TP, compared to 0.015+-0.005 TP obtained from the macroscopic hydrodynamical calculations. The viscosity coefficient determined from the microscopic calculations is even larger if the dissipated energies are compared at a finite scission neck radius. As a possible resolution of this discrepancy, we propose that level splittings arising from axially asymmetric and reflection-asymmetric deformations during the descent from the saddle point to scission reduce the energy dissipation and make the nuclei only moderately viscous. (AIP)

NUCLEAR MODELS

12072 (CONF-751227—1) **Statistical theory of neutron nuclear reactions.** Moldauer, P.A. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 24p. Dep. NTIS $3.50.

From IAEA consultants meeting on use of nuclear theory in neutron nuclear data evaluation trieste; Argonne, Illinois, United States of America ªUSAª (8 Dec 1975).

The statistical theory of average neutron nucleus reaction cross sections is reviewed with emphasis on the justification of the Hauser Feshbach formula and its modifications for situations including isolated compound nucleus resonances, overlapping and interfering resonances, the competition of compound and direct reactions, and continuous treatment of residual nuclear states. 3 figures. (auth)

12073 **Perturbative approximations to the effective interaction: Comparisons with exact results for large matrices.** Pittel, S.; Vincent, C.M.; Vergados, J.D. (Bartol Research Foundation of The Franklin Institute, Swarthmore, Pennsylvania 19081). *Phys. Rev., C;* **13**: No. 1, 412-429(Jan 1976).

The effective interaction appropriate to a (2s-1d)^2 model space is studied for the J/sup π/=0$^+$ states of ^{18}O. Perturbation theory and various Pade approximants are compared with exact results obtained by solving large shell-model problems that realistically include many 3p-1h and 4p-2h states. We analyze two cases that differ only in the choice of the (2s-1d) single-particle energies. In one, there is a collective 4p-2h intruder state, as well as several intruders at negative values of the coupling parameter. The perturbation theory expansion for the effective interaction is found to diverge in this case. The other case has no intruders and the perturbation expansion seems to converge. In both cases, third-order perturbation theory is found to be more accurate than second order, and gives matrix elements correct to 200 keV. The intruder states do not seem to be responsible for the fact that third-order terms are often larger than second-order terms. The [N+1, N] Pade approximants of low orders are less accurate than third-order perturbation theory. However, the operator-valued [1,2] Pade approximant is accurate to 130 keV, for reasons that are not yet understood. (AIP)

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 11352, 11699

12074 (CONF-751101—56) **Preliminary cross-section sensitivity analysis for an air-over-ground environment.** Pace, J.V. III; Bartine, D.E. (Oak Ridge National Lab., Tenn. (USA)). 1976. 4p. Dep. NTIS $4.50.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Two-dimensional sensitivity calculations were made for an air-over-ground geometry to determine the effect of air and ground cross-section perturbations on the total neutron and gamma ray dose near the air/ground interface and 415 meters above the ground. ENDF/B 22 neutron and 18 gamma group Version IV cross-sections were used in all computations. (auth)

12075 (RD/B/N—3178) **User's manual for the three-dimensional Monte Carlo transport code SPARTAN. (SPARTAN development report 3).** Bending, R.C.; Heffer, P.J.H. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Sep 1975. 67p. (FREDSWG/P—(75)9; RPC/Sh/P—(75)11; FRCMWG/P—(75)163). Dep. NTIS (US Sales Only) $4.50.

SPARTAN is a general-purpose Monte Carlo particle transport code intended for neutron or gamma transport problems in reactor physics, health physics, shielding, and safety studies. The code uses a very general geometry system enabling a complex layout to be described and allows the user to obtain physics data from a number of different types of source library. Special tracking and scoring techniques are used to improve the quality of the results obtained. To enable users to run SPARTAN, brief descriptions of the facilities available in the code are given, and full details of data input and job control language, as well as examples of complete calculations, are included. It is anticipated that changes may be made to SPARTAN from time to time, particularly in those parts of the code which deal with physics data processing. The load module is identified by a version number and implementation date, and updates of sections of this manual will be issued when significant changes are made to the code. (auth)

12076 (UCID—17005) **Use of implicit Monte Carlo radiation transport with hydrodynamics and Compton scattering.** Fleck, J.A. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1971. Contract W-7405-Eng-48. 12p. Dep. NTIS $3.50.

It is shown that the combination of implicit radiation transport and hydrodynamics, Compton scattering, and any other energy transport can be simply carried out by a "splitting" procedure. Contributions to material energy exchange can be reckoned separately for hydrodynamics, radiation transport without scattering, Compton scattering, plus any other possible energy exchange mechanism. The radiation transport phase of the calculation would be implicit, but the hydrodynamics and Compton portions would not, leading to possible time step controls. The time step restrictions which occur on radiation transfer due to large Planck mean absorption cross-sections would not occur. (GHT)

12077 (UCID—17012) **Equations for a two-dimensional diffusion routine.** Sutcliffe, W.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1974. Contract W-7405-Eng-48. 23p. Dep. NTIS $3.50.

The equations for a two dimensional diffusion routine including boundary conditions and flux limiting are presented. The method of solution is simply a reduction to one dimension by ADI or splitting and application of the usual back substitution method. (auth)

12078 **Monte Carlo splitting surface identification by pattern recognition.** Macdonald, J.L. (Los Alamos Scientific Lab., NM); Koen, B.V.; Cashwell, E.D. *Trans. Am. Nucl. Soc.;* **22**: 281-282(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12079 **Inelastic-interaction mean free path of negative pions in tungsten.** Cheshire, D.L.; Huggett, R.W.; Jones, W.V.; Rountree, S.P.; Schmidt, W.K.H.; Kurz, R.J.; Bowen, T.; DeLise, D.A.; Krider, E.P.; Orth, C.D. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). *Phys. Rev., D;* **12**: No. 9, 2587-2593(1 Nov 1975).

The inelastic-interaction mean free paths λ of 5-, 10-, and 15-GeV/c pions have been measured by determining the distribution of first-interaction locations in a modular tungsten-scintillator ionization spectrometer. In addition to commonly used interaction signatures of a few (2—5) particles in two or three consecutive modules, we have used a chi^2 distribution to calculate the probability that the first interaction occurred at a specific depth in the spectrometer. This latter technique seems to be more reliable than use of the simpler criteria. No significant dependence of λ on energy has been observed. In tungsten, λ for pions is 206 +- 6 g/cm^2. (AIP)

12080 **Flux distribution calculations in planar channeling.** Ellison, J.A. (Univ. of New Mexico, Albuquerque). *Phys. Rev., B;* **12**: No. 11, 4771-4779(1 Dec 1975).

A technique was developed to calculate the spatial and velocity distributions of channeled ions in planar channeling as a function of the depth in a crystal. The continuum plane approximation is assumed but no assumptions about statistical equilibrium are made. At fixed depths, the distributions are found to exhibit both jump discontinuities and infinities, so an integral of the distributions over small intervals around various positions across the channel is calculated. Also, the distributions are found to change considerably with depth and the integrals as a function of depth give a clear picture of the flux-peaking phenomenon. The key idea in this technique is an examination of the motion of the ions in the phase plane; this turns out to be a very systematic way of ordering the particles and thereby gaining insight into the structure of the distributions. The technique is illustrated by examining the evolution of the spatial distribution with depth for channeling of 1-MeV helium ions along the [110] planes of silicon. 11 figures. (auth)

12081 **Energy deposition of superpinched relativistic electron beams in aluminum targets.** Perry, F.C.; Widner, M.M. (Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Appl. Phys.;* **47**: No. 1, 127-134(Jan 1976).

Dynamic response data, which traditionally have been used to obtain equation-of-state (EOS) information of materials, were instead used here to study energy deposition of an intense (~10^{11} W/cm^2) tightly focused relativistic electron beam (REB). Measurements of the REB-induced shock-wave transit time and average rear-surface velocity were compared with two-dimensional hydrodynamic calculations which contain well-known EOS information for 6061-T6 aluminum. The experimental results were consistent with classical electron deposition, i.e., a one-dimensional Monte Carlo transport calculation. In addition, peak pressures in

the range 1—2 Mbar (0.1—0.2 TPa) were implied. Two anomalous effects were observed: (i) a low-amplitude (free-surface velocity ~10^4 cm/sec) precursor signal, preceding the REB-induced shock wave and (ii) a velocity distribution of material behind the rear surface of the target following the arrival of the REB-induced shock wave. (AIP)

SHIELDING CALCULATIONS AND EXPERIMENTS

REFER ALSO TO CITATION(S) 12078

MEDICAL PHYSICS

RADIATION PROTECTION STANDARDS

REFER ALSO TO CITATION(S) 11620

DOSIMETRY

REFER ALSO TO CITATION(S) 10345

12082 (CONF-751101—53) **Pediatric phantoms for use in dosimetric calculations.** Shoup, R.L.; Hwang, J.L.; Poston, J.W.; Warner, G.G. (Oak Ridge National Lab., Tenn. (USA)). 1976. 14p. Dep. NTIS $4.50.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Estimating absorbed doses to children from external and internal radiation sources has become important to the nuclear industry and pediatric nuclear medicine. The Medical Physics and Internal Dosimetry Section at ORNL has recently completed the design of mathematical representations of children of ages newborn, 1 year, and 5 years old. These mathematical representations will be referred to as pediatric phantoms. Using these phantoms, relevant energy deposition data have been developed which establish a meaningful model for use in estimating radiation dose to children. (auth)

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 12095

12083 (ITP—75-43R) **Light absorption by singlet and double triplet excitations.** Sukhorskaya, N.A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 15p. (In Russian). Dep. NTIS (US Sales Only) $3.50.

The light absorption by singlet and double triplet excitations is studied in a cubic crystal with a molecule in an elementary cell under the condition that they possess close or coinciding energies. It is shown that with increasing distance between singlet and double triplet excitations the band absorption decreases proportionally to the square of the ratio of singlet-double triplet interaction to the distance between them. Then there exists the absorption on singlet and coupled double triplet excitations. When the singlet energy occurs inside the double triplet excitation band the absorption line has its width conditioned by the interaction value of singlet and double triplet excitations. Strongly mixed bounded states of singlet and double triplet excitons arise. (auth)

12084 (ITP—75-73E) **Theory of migration of incoherent excitons.** Onipko, A.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 10p. Dep. NTIS (US Sales Only) $3.50.

The probability of a localized exciton jump between molecules with allowance for exciton-exciton interaction is obtained in the adiabatic approximation. At the temperatures above Debye's one the analytic dependence of the probability upon the parameter of the exciton-exciton interaction is found and the role of the interaction in the annihilation process is discussed. (auth)

12085 (ITP—75-74E) **Annihilation of incoherent excitons in molecular crystals with allowance for their interaction.** Onipko, A.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 20p. Dep. NTIS (US Sales Only) $3.50.

The dependence of the exciton annihilation rate on the dynamic interaction between excitons is studied in molecular crystals. The equation of motion for the two-particle density matrix of incoherent excitons is used to obtain an expression for the annihilation rate constant in one-, two-, and three-dimensional crystals. It is shown that the interaction between excitons can affect considerably the annihilation rate and its temperature dependence and the contribution of the exciton-exciton interaction to the annihilation process depends on the dimensionality of a system in which excitons move. 29 refs. (auth)

12086 (ITP—75-96E) **Spatial dispersion and light propagation in crystals.** Davydov, A.S. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 79p. Dep. NTIS (US Sales Only) $5.00.

Light propagation in crystals with spatial dispersion is investigated theoretically. The phenomenological and quantum-statistical theories are used to investigate the specific features of light propagation in crystals in the exciton absorption region. The relaxation processes which are essentially dependent on the crystal temperature are taken into account. The rearrangement of the dispersion curves under the passage over the "critical" temperature which is dependent on the character of an electronic excitation and on the nature and purity of a crystal is discussed. (auth)

12087 (RT/EL—(75)3) **Impurity redistribution in semiconductors with surface rate limitation.** Catoni, F.; Coiante, D. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Apr 1975. 14p. Dep. NTIS (US Sales Only) $3.50.

The impurity redistribution in a semiconductor is obtained in the real case of boundary condition: a) erfc-type dopant initial distribution, b) finite value of rate limitation at semiconductor surface. (auth)

12088 **Thermal and magnetic behavior of one-dimensional magnets.** Gerstein, B.C. (Ames Lab., IA). pp 125-146 of In Low-dimensional cooperative phenomena. Keller, H.J. (ed.). New York; Plenum Publishing Corp. ([nd]).

Static thermal and magnetic behavior of one dimensionally interacting magnetic solids are dealt with. Magnetic heat capacities and susceptibilities of such systems are treated. In keeping with the spirit of the ASI as a "school," the material is quite elementary, with the idea of introducing the reader to the concept of how non-interacting three dimensional systems behave, how this behavior differs from that expected for lower dimensional systems, and to the techniques used to calculate thermodynamic properties of lower dimensional systems. Emphasis is on the manner in which thermodynamic behavior changes as 1-D and higher dimensional interactions become important. Classic calculations to illustrate this point are considered in detail. The following topics are included: (I) the physical basis of the "exchange" interaction, (II) superexchange, (III) initial susceptibility and magnetic heat capacities of systems with zero exchange (Curie Law behavior and Schottky heat capacities), and (IV) the transfer matrix technique for Ising Model calculations, with, and without a molecular field. 2 tables, 3 figures. (auth)

12089 **Self-consistent relativistic APW method with the spin-orbit interaction treated as a perturbation.** Boyer, L.L.; Klein, B.M. (Naval Research Lab., Washington, DC). *Int. J. Quant. Chem., Symp.;* No. 9, 511-518(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

A simple method for including spin-orbit corrections in self-consistent relativistic APW band structure calculations is presented in which the spin-dependent part of the APW matrix is treated as a perturbation. The solution of the spin-independent problem is used in a way that requires little additional time or coding to include spin. The full calculational procedure is discussed and calculations of spin-orbit splitting in TaC are described to illustrate the method. (auth)

12090 **Local excitations in crystalline systems.** Collins, T.C.; Kunz, A.B.; Ivey, J.L. (Aerospace Research Labs., Wright Patterson Air Force Base, OH). *Int. J. Quant. Chem., Symp.;* No. 9, 519-527(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Three systems are considered which have large local field effects in their excited spectra. The first system is the absorption of soft x-ray radiation by the insulating crystal LiF, for which the lowest excitonic transition from the core state to the conduction band is forbidden. Next the optical properties of LiF in the 1—2-Ry energy range are examined. The last system discussed is NiO where the excitation spectra in the 0—20-eV energy range are investigated. In all three systems it is pointed out that a proper description must go beyond simple Hartree—Fock band theory and should include short-range correlation effects as well as the usual long-range correlations. (auth)

12091 Polarization calculations for ferroelectric sodium nitrite. Henkel, J.H.; Collins, T.C.; Ivey, J.L.; Euwema, R.N. (Aerospace Research Labs., Wright Patterson Air Force Base, OH). *Int. J. Quant. Chem., Symp.;* No. 9, 529-533(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Energy bands were calculated for ferroelectric sodium nitrite using a plane-wave Gaussian basis set and an Xα exchange. Wave functions were calculated at five symmetry k points, and the electron charge density was averaged over the five symmetry points. The electric dipole moment per unit molecule was calculated by assuming that the boundaries of a neutral molecule were given by minimum charge density contours. The spontaneous polarization for ferroelectric sodium nitrite calculated using the above assumption was 9.9 x 10^{-6} C/cm², which agrees with the experimental value of 9.5 x 10^{-6} C/cm² measured by Tokugawa. (auth)

12092 Electronically driven instabilities in metals. Freeman, A.J. (Argonne National Lab., IL); Myron, H.W.; Rath, J.; Gupta, R.P. *Int. J. Quant. Chem., Symp.;* No. 9, 535-550(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Electronically driven instabilities of the conduction electrons in metals are manifested as spin density waves, charge density waves accompanied by periodic lattice distortions, or in structural phase transformations and are thought to result from a divergence in chi(q), the generalized static electronic susceptibility. Examples of these instabilities are discussed by means of accurate calculations of the noninteraction conduction electron susceptibility chi(q) using results of energy-band calculations and our recently developed analytic tetrahedron linear energy method, notably, the occurrence of change density waves in the layered dichalcogenides and the body-centered cubic to omega phase transformation in metals like Zr. (auth)

12093 Band structure of the TCNQ—TTF system. Ladik, J. (National Institutes of Health, Bethesda, MD). *Int. J. Quant. Chem., Symp.;* No. 9, 563-567(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

On the basis of already performed SCF all-valence electron crystal orbital calculations one can conclude that the conduction band of poly($TCNQ^-$) and the valence band of poly(TTF^+) will cross only when the interactions between the charged polyradical chains are taken into account in a proper way. The different main steps to obtain a realistic band structure of the rather complex TCNQ—TTF system (which could serve as a starting point for the interpretation of its unusual conduction properties) are briefly outlined. (auth)

12094 Thermoelectric power due to electronic hopping motion. Emin, D. (Sandia Labs., Albuquerque, NM). *Phys. Rev. Lett.;* 35: No. 13, 882-885(29 Sep 1975).

A theory of the thermoelectric power associated with electronic phonon-assisted tunneling (hopping) motion between inequivalent sites has been developed. The general results have been applied to some prototype situations characteristic of hopping in disordered solids. (auth)

SUPERCONDUCTIVITY

REFER ALSO TO CITATION(S) 11007, 11019, 11021, 12093

12095 Large electron—phonon interaction but low-temperature superconductivity in LaB_6. Arko, A.J. (Argonne National Lab., IL); Crabtree, G.; Ketterson, J.B. *Int. J. Quant. Chem., Symp.;* No. 9, 569-578(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Combined experimental and theoretical studies are reported of the Fermi surface, band structure, generalized magnetic susceptibility, electron—phonon enhancement factor lambda, and superconducting transition temperature T/sub c/ of LaB_6. Whereas the unusually large lambda values, ranging from 1.0 to 2.5, are expected to result in high T/sub c/ values, T/sub c/ is observed to be only 0.122°K. These results further emphasize the need for appropriate theoretical formulations for these systems. (auth)

GENERAL THEORY

12096 (CONF-751160—1) **Radiation effects on superconductivity.** Brown, B.S. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 37p. Dep. NTIS $4.00.

From ASM seminar on materials science; Cincinnati, Ohio, United States of America [sic] (9 Nov 1975).

The effect of radiation on the superconducting transition temperature (T/sub c/), upper critical field (H/sub c2/), and volume-pinning-force density (F/sub p/) were discussed for the three kinds of superconducting material (elements, alloys, and compounds). 11 figures, 3 tables, 86 references. (auth)

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 10971, 10973, 11008, 11025, 11026, 11028, 11029, 11031, 11051, 11236

12097 PROCEEDINGS OF THE FIFTH INTERNATIONAL CRYOGENIC ENGINEERING CONFERENCE, KYOTO, JAPAN, MAY 7—10, 1974. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974). 584p. (CONF-740509—). pounds 35.00.

From 5. international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

REFER ALSO TO CITATION(S) 11704, 11750, 11752, 11753, 11755, 11756, 11757, 12086

12098 Remark on time evolution and spectral concentration. Braendas, E.; Froelich, P. (Univ. of Florida, Gainesville). *Int. J. Quant. Chem., Symp.;* No. 9, 457-459(1975).

From Proceedings of the international symposium on atomic, molecular, and solid-state theory and quantum statistics; Sanibel Island, FL, USA (19 Jan 1975).

Irreversibility is studied from the point of view of a time-dependent partitioning technique, based on retarded and advanced evolution operators. Application to the Stark effect in the hydrogen atom showed that correct numerical results for the real part of the resonance, that is, the complex pole of the Green's function, could be obtained. (GHT)

RELATIVITY AND GRAVITATION

REFER ALSO TO CITATION(S) 11662

12099 Equivalence between the Einstein—Cartan and general relatively theories in the linear approximation for a classical model of spin. Adamowicz, W. (Univ., Warsaw). *Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.;* 23: No. 11, 1203-1205(1975).

It is pointed out that in the linear approximation of the Einstein—Cartan theory a set of rotating bodies and a fluid with the classical model of spin give the same metric of space-time. (auth)

12100 Unified geometry of internal space with space-time. Cho, Y.M.; Jang, P.S. (The Enrico Fermi Institute and Department of Physics, The University of Chicago, Chicago, Illinois 60637). *Phys. Rev., D;* 12: No. 12, 3789-3792(15 Dec 1975).

The unified theory of gravitation with gauge fields proposed earlier is shown to be a (4 + n) -dimensional Einstein theory with n linearly independent complete spacelike Killing vector fields which span an n-dimensional metric submanifold and form a closed Lie algebra. In this picture the internal space is combined with space-time and the internal symmetry becomes a symmetry of the metric of the (4 + n) -dimensional combined space. The 4-dimensional space-time appears as the quotient space of the (4 + n) -dimensional enlarged space by the equivalence relation of the group of motions of the n Killing vector fields. (AIP)

ELECTRICITY AND MAGNETISM

12101 (ERDA-tr—114) **Spatial nonuniform conductivity and force-free magnetic fields.** I. Gopasyuk, S.I. Translated from *Izv. Krym. Astrofiz. Obs.;* 41-42: (1970). 10p. Dep. NTIS $3.50.

The influence of non-uniform conductivity on the structure of a force-free magnetic field is examined. Using Maxwell's equations and Ohm's law it is shown that the magnetic field cannot be force-free if conductivity is non-uniform. There exists force-free

configuration in the case of uniform conductivity. Assuming axial symmetry the general solution of the equation describing a force-free magnetic field is given. Both integrals for the equations of the lines of force have been found. This solution shows that the magnetic field decreases exponentially with height. (auth)

MATHEMATICAL PHYSICS

12102 (IFA-FA—1-1975) **Reduction theory.** Teleman, S. (Institutul de Fizica Atomica, Bucharest (Romania)). 1975. 32p. Dep. NTIS (US Sales Only) $4.00.

The theory announced previously is developed. We recall that in [5] are applied the Choquet-Bishop-de Leeuw theory in order to obtain an irreducible disintegration theory for any continuous unitary representation of any locally compact group, as well as a spatial reduction theory for any von Neumann algebra. Some fields of Hilbert spaces, which were very close to the integrable fields as defined by W. Wils (see [6], definition 1.1.), but the second condition in that definition was satisfied only in a weakened form. It is shown that, by using W. Wils' central measures instead of the Choquet-Bisop-de Leeuw maximal measures, one can obtain, by a method quite similar to that developed previously, a similar theory, which, as compared with the previous one, has the advantage of providing integrable fields of Hilbert spaces, as defined by W. Wils.

CONTROLLED THERMONUCLEAR RESEARCH

12103 (PB—238901) **Report of NRL progress.** (Naval Research Lab., Washington, D.C. (USA)). Nov 1974. 46p. NTIS $3.75.

Progress of the plasma physics division is reported. Progress notes are also included on: acoustics, fracture mechanics, magnetic materials, mathematics, metallurgy, ocean technology, radio and radar, space science, space systems, and supporting techniques. Papers by NRL staff members and patents are listed. (GRA)

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

12104 (AD/A—006111) **Propagation of high-power laser radiation in partially ionized gases. Physical sciences research papers.** Papa, R.J.; Taylor, R.L. (Air Force Cambridge Research Labs., L.G. Hanscom Field, Mass. (USA)). 23 Oct 1974. 80p. (AFCRL-PSRP—607; AFCRL-TR—74-0532). NTIS $4.75.

When a laser beam of sufficiently high intensity interacts with a weakly ionized gas, the nonuniform deposition of laser energy into the electron gas causes heating of the electrons, ions, and neutral gas. Eventually, the neutral gas will "break-down" and become more highly ionized. This ionization can seriously limit the amount of laser energy that can damage a target. A multifluid model has been devised to describe the many physical processes that occur when the high-power laser wave interacts with the partially ionized gas. A flexible computer program has been developed to numerically integrate the multifluid plasma transport equations coupled with Maxwell's equations. The computer program is sufficiently general so as to be capable of describing target vaporization, with diffusion and ionization of target material into an ambient gas. In this report, only the modification of an ambient gas by the laser radiation is studied. (GRA)

12105 (CONF-751125—116) **Power and phase monitoring system for the lower hybrid phased array heating system on ATC machine.** Reed, B.W. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 20p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A four waveguide phased array slow wave structure has been constructed to couple microwave energy into plasma in the ATC Tokamac at Princeton. Theory has indicated that the coupling of power into the plasma column is a strong function of the imposed fourier spectrum at the antenna aperture. To optimize heating, and to verify theoretical results, a precision amplitude and phase monitoring system has been designed and constructed. The system data output is routed to an IBM 1800 computer where the fourier spectrum in n/sub parallel/ space is computed for discrete increments of time during an RF pulse. Computer output data is used to update the adjustment of transmission line parameters in between pulses. (auth)

12106 (COO—2180-7) **Studies of charged particle distributions in an electrostatic confinement system. Progress report, 1 November 1971—31 January 1976.** Gardner, A.L. (Brigham Young Univ., Provo, Utah (USA). Dept. of Physics and Astronomy). 1976. Contract AT(11-1)-2180. 14p. Dep. NTIS $3.50.

Microwave cavity techniques were used to measure electron density in a spherical, inertial-electrostatic confinement device using six ion guns. The density was roughly proportional to ion current (1 to 17 mA) and decreased somewhat with increasing ion energy (10 to 37 keV). With D_2 pressure decrease from 10 to 3 mTorr, n/sub e/ decreased faster than linearly and below approximately 3 mTorr decreased linearly with pressure down to the lowest pressure of 0.4 mTorr. At 1 mTorr and 10 mA, measurements (with poor spatial resolution) were consistent with 10^{10} total electrons and a central n/sub e/ of 10^9 electrons/cm^3. Neutron flux (at 50 keV) was about one sixth that of Hirsch (J. Appl. Phys. 38, 4522 (1967)). Six- vs. three-gun operation showed a small enhancement of both n/sub e/ and neutron flux that may indicate some particle trapping.

12107 (MATT—1172) **High frequency parametric wave phenomena and plasma heating: a review.** Porkolab, M. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Nov 1975. Contract E(11-1)-3073. 70p. (CONF-750877—2). Dep. NTIS $4.50.

From 12. international conference on phenomena in ionized gases; Eindhoven, Union of Soviet Socialist Republics [*]USSR[*] (Aug 1975).

A survey of parametric instabilities in plasma, and associated particle heating, is presented. A brief summary of linear theory is given. The physical mechanism of decay instability, the purely growing mode (oscillating two-stream instability) and soliton and density cavity formation is presented. Effects of density gradients are discussed. Possible nonlinear saturation mechanisms are pointed out. Experimental evidence for the existence of parametric instabilities in both unmagnetized and magnetized plasmas is reviewed in some detail. Experimental observation of plasma heating associated with the presence of parametric instabilities is demonstrated by a number of examples. Possible application of these phenomena to heating of pellets by lasers and heating of magnetically confined fusion plasmas by high power microwave sources is discussed. (auth)

12108 (MATT—1173) **Waveguide and loop coupling to fast MHD toroidal eigenmodes.** Paoloni, F.J. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 28p. Dep. NTIS $4.00.

Heating of plasmas by wave techniques requires an effective method of coupling rf energy to the plasma. In cavities the presence of weakly damped eigenmodes will enhance the loading of antennas when the wave frequency equals an eigenmode frequency. This report considers two methods of coupling to fast MHD eigenmodes in a toroidal cavity: one is by a waveguide mounted perpendicular to the vacuum vessel wall; and the other by a loop placed within the cavity. (auth)

12109 (MATT—1175) **Suppression of heavy impurities in the ST Tokamak.** Meservey, E.; Bretz, N.; Dimock, D.; Hinnov, E. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 6p. Dep. NTIS $4.00.

Two different discharges in the ST Tokamak are described: A discharge dominated by high-Z (iron) impurity (Case A), and one dominated by low-Z (oxygen) impurity (Case B). The oxygen-dominated discharge shows higher electron temperature and longer containment time than the iron-dominated discharge. Suppression of Fe and Mo impurities has been achieved by pulsing in air for a few hundred shots. (auth)

12110 (MATT—1185) **R.F. heating near the lower hybrid frequency in the FM-1 spherator.** Hawryluk, R.J.; Davis, S.L.; Schmidt, J.A. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 29p. Dep. NTIS $4.00.

Plasma heating experiments at frequencies near the lower hybrid frequency have been carried out at modest powers (.05 to 4kW). The antenna structure operating at 68 MHz was comprised of two plates driven out of phase on the exterior of the plasma. High electron heating efficiency (greater than 40 percent) in both helium and argon plasmas was observed with only a weak density dependence. At low densities (n/sub e/ less than or equal to 1 x 10^{11} cm^{-3}), the heating was uniform across the plasma while at higher densities the heating was preferentially on the exterior portion of the plasma. The heating of the exterior of the plasma was found not to correspond to absorption at the lower hybrid resonance layer. The electron heating efficiency was found to be a weak function of rf power when the incident rf power was varied

from 1 to 15 times the experimentally observed threshold power for parametric instabilities. Ion temperatures were determined by measuring the Doppler broadening of an Argon ion line using a Fabry-Perot interferometer. Low efficiency main body ion heating (1 to 3 percent) was observed. (auth)

12111 (MATT—1195) **Small-scale density fluctuations in the adiabatic toroidal compressor.** Mazzucato, E. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Feb 1976. Contract E(11-1)3073. 10p. Dep. NTIS $4.00.

A new class of density fluctuations has been observed in the ATC tokamak by using spectral analysis of scattered microwaves. The observed frequency spectrum is consistent with that of drift waves with amplitudes that are maximum in the wavelength range 0.5 to 1.0 cm where finite ion Larmor radius effects are important for plasma stability. The total density fluctuation is n tilde/sub e/ greater than or equal to 5 x 10^{-3} anti n/sub e/. It is estimated that these fluctuations could account for a large fraction of the electron energy losses of the ATC discharge. (auth)

12112 (ORO—4338-8) **Continuation of investigation of turbulent heating schemes. Annual progress report.** Jones, W.D.; Oleson, N.L. (University of South Florida, Tampa (USA)). 24 Feb 1976. Contract AT(40-1)-4338. 36p. Dep. NTIS $4.00.

In the past year, the linear turbulent-heating device was modified and improved, three new major diagnostic systems were put into operation, and most important of all, the catalytic turbulent-heating by spatial magnetic field variations was successfully demonstrated. One basic goal is to increase the efficiency of coupling energy into low frequency modes which in turn heat the ions selectively. The experimental results strongly indicate this is the case. It is conceivable that ion heating can be improved by the presence of either intentional or unavoidable magnetic field variations.

12113 (ORO—4627-2) **Penetration of magnetic fields into plasmas and heating of a collisionless plasma by radio frequency waves. Progress report.** Bengtson, R.D.; Oakes, M.E. (Texas Univ., Austin (USA). Dept. of Physics). 1975. 8p. Dep. NTIS $3.50.

Experimental work is completed on the effects of neutrals on magnetic piston and sheath development. A preliminary form of this work was presented at the American Physical Society meeting in November, 1975 and is included as appendix. In this work, the measurement and analysis of the current sheath with a data reduction to the microscopic collision frequencies, is also included. The rotation of the plasma during the implosion was detected. Indications are that observations of a nonradial component of the electric field can be related to plasma rotation. (auth)

12114 (TID—27002) **Plasma heating with a rotating relativistic electron beam. I. Return current processes.** Molvig, K.; Rostoker, N. (California Univ., Irvine (USA). Dept. of Physics; Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). 1974. Contract AT(04-3)-34. 55p. Dep. NTIS $4.50.

An advantageous configuration for plasma heating with a relativistic beam utilizes an annular beam rotating about a guide magnetic field. In this first paper (of two), the return current process for such a configuration is considered. For the parameters expected to prevail in an experiment, the plasma response can be described as magnetic diffusion or critically damped magnetosonic waves - these being equivalent. Equations for the axial and angular return currents are derived and take the form of decoupled diffusion equations. The effects of pulse shape, boundary conditions, etc. are then treated. The drag force on the beam resulting from the interaction is greatly enhanced and leads to a stopping length reduction by the factor $^1/_3$(V/sub parallel bars//c)^3 as compared to non-rotating beams. The implications of these effects for a plasma heating application are discussed.

12115 (UCID—17037) **Status of 2XIIB plasma confinement experiments.** Coensgen, F.J.; Clauser, J.F.; Correll, D.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Feb 1976. Contract W-7405-Eng-48. 76p. Dep. NTIS $5.00.

This report describes the status of 2XIIB neutral beam injection experiments with stabilizing plasma. The stream suppresses ion-cyclotron fluctuations and permits density to 5 x 10^{13} cm^{-3}. The ion energy is 13 keV, and electron temperature reaches 140 eV. Plasma confinement increases with ion energy and n tau reaches 7 x 10^{10} cm^{-3}.s at 13 keV. The n tau energy scaling is consistent with electron drag and ion-ion scattering losses. Buildup on a streaming plasma in a steady-state magnetic field is described. (auth)

12116 **Plasma loss in the levitated toroidal octupole.** Cavallo, A.J. Madison, WI; Univ. of Wisconsin (1975). 211p. University Microfilms Order No. 75-19,058.

Thesis (Ph. D.).

A detailed experimental investigation of plasma loss to the rings and walls of the levitated octupole has been made. The region around the internal rings of the octupole was of special interest, since this region can have absolute magnetohydrodynamic (MHD) stability when the plasma density gradient is directed away from the ring. Loss to the ring can be measured without supports or obstacles near the ring obscuring details of plasma behavior. Loss to the walls of the octupole was measured with 40 cm^2 striped collector patches distributed around the machine, and with collectors mounted on a moveable cart. Loss to the rings was measured by 320 cm^2 striped collector bands wrapped around the minor circumference of a ring. Loss information could be telemetered from the rings via a modulated light beam, with all wires, probes and supports removed from the vicinity of the ring. (Diss. Abstr. Int., B)

12117 (ORNL-tr—4088) **Loss of neutrals to the wall due to charge exchange during neutral beam injection into a toroidal plasma.** Putvinskii, C.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1975. Translation by J.H. Harris of IAE—2520. 19p. Dep. NTIS $3.50.

A theoretical description of the problem is given. The behavior of the injected neutrals is determined by the following elementary processes: resonant charge exchange with the plasma ions, electron impact ionization, and ionization by ion collisions. Some numerical calculations are given. (MOW)

12118 (ORNL-tr—4080) **Plasma heating in the TM-3 Tokamak at electron-cyclotron resonance with magnetic fields up to 25 ke.** Alikaev, V.V.; Bobrovskii, G.A.; Poznyak, V.I.; Razumova, K.A.; Sannikov, V.V.; Sokolov, Yu.A.; Shmarin, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1975. Translation by S.D. Blalock Jr. of IAE—2564. 8p. Dep. NTIS $3.50.

Experiments were conducted in heating plasma at electron-cyclotron resonance (ECR) with longitudinal magnetic fields up to 25 ke. It was shown by the aid of laser diagnosis that the temperature of the basic component of the electrons increases in accordance with the classical mechanism of heating at ECR in the process of electron-cyclotron heating (ECH). The distribution of the temperature of electrons with respect to radius was measured. The relationship of energetic lifetime in the Tokamak and electron temperature was obtained and the magnitude of energetic lifetime of accelerated electrons in the function of their energy was estimated. The value β/sub tau/ approximately equal to 2.2 was obtained by the aid of ECH in a regime with small discharge currents.

12119 **Trapping and confinement of relativistic electron rings in a stabilized mirror field without conducting wall.** Luckhardt, S.C.; Woodall, D.M.; Fleischmann, H.H. (Physics Department of Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14853). *Phys. Rev. Lett.*; 35: No. 26, 1758-1760(29 Dec 1975).

Experimental studies indicate that electron rings can be trapped and confined in Astron geometry without a stabilizing conducting wall if a quadrupole-Ioffe or toroidal magnetic field is applied. The ring characteristics are similar to those previously observed in the presence of a conducting wall. All rings trapped with a toroidal field appear to be stably confined. In a Ioffe field, rings with axial self-fields δBapproximately-less-than0.6B_e exhibit a faster-than-usual initial ring decay. (AIP)

12120 **Adiabatic invariance and charged-particle confinement in a geometric mirror.** Samec, T.K.; Lee, Y.C.; Fried, B.D. (University of California, Los Angeles, Los Angeles, California 90024). *Phys. Rev. Lett.*; 35: No. 26, 1763-1766(29 Dec 1975).

We show that the motion of charged particles, radially confined by slowly converging surface magnetic fields to the interior, r<R (z), of a cylindrical region, has an adiabatic invariant for (dR/dz) very-much-less-than1. This provides axial confinement of particles outside of a loss cone, with critical velocity pitch angle given by $\sin^2\theta$/subc/= (R/sub min/R/sub max/)^2. Computational results verifiying the theory are presented and the single-particle lifetime, tau, is found to scale as vertical-bardRdzvertical-bar^{-2} for suitably smooth R (z). (AIP)

12121 **Turbulent pusher behavior.** McCrory, R.L.; Morse, R.L. (Theoretical Division, University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Fluids*; 19: No. 1, 175-176(Jan 1976).

Model calculations suggest that turbulence resulting from instability of laser driven ablatively imploded high aspect ratio pusher shells in which the unstable region is, in general, distinctly narrower than the shell will degrade, but not exclude, useful compression of these systems. (AIP)

12122 Ion-cyclotron resonance heating of plasmas and associated longitudinal cooling. Busnardo-Neto, J.; Dawson, J.; Kamimura, T.; Lin, A.T. (Physics Department, University of California, Los Angeles, California 90024). *Phys. Rev. Lett.*; **36**: No. 1, 28-31(5 Jan 1976).

We have investigated, via a 1—2/2 dimensional computer simulation, the possibility of forcing an initially isotropic, magnetized plasma into an anisotropic state by means of an external pump. Strong heating of the perpendicular ion temperature was observed together with a strong cooling of the longitudinal temperature. This mechanism could enhance particle trapping in tokamaks and increase confinement time in mirror machines. We use basic physical arguments to predict the maximum temperature ratio that can be obtained. (AIP)

12123 Absorption of laser light on self-consistent plasma density profiles. Forslund, D.W.; Kindel, J.M.; Lee, K.; Lindman, E.L. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev. Lett.*; **36**: No. 1, 35-38(5 Jan 1976).

The long-term absorption and scattering of light obliquely incident on an inhomogeneous and self-consistent evolving plasma profile including differential ion flow is considered. In general, the plasma has a sharp rise in density from subcritical to supercritical. The subcritical density decreases for increasing radiation pressure relative to the plasma pressure. In this profile an instability develops of the radiating decay type which modulates and generally enhances the absorption. The plasma density profile appears to evolve toward large light absorption. (AIP)

12124 (MATT-Trans—120) Heating of plasma in the TM-3 Tokamak at the resonance with magnetic fields up to 25 kOe. Alikaev, V.V.; Bobrovski, G.A.; Pozniak, V.j.; Razumoa, K.A.; Sannikov, V.V.; Sokolov, Yu.A.; Shmarin, A.A. Feb 1976. Translated by N. Turitzin. 15p. Dep. NTIS $3.50.

Plasma heating experiments were conducted in electron-cyclotron resonance (ECR) with magnetic fields of up to 25 kOe. It was shown, using laser diagnostics that during the electron-cyclotron heating (ECH) the temperature of the main electron component grows in accordance with the classical heating mechanism of ECR. The radial electron temperature distribution was measured. The relationship between the energy confinement time in the tokamak and the electron temperature was obtained, and the magnitude of the energy confinement time of the accelerated electrons as a function of their energy was evaluated. Using ECH, the value β/sub I/ approximately equal to 2.2 was obtained for low-current discharges. (auth)

12125 Self-trapping of a laser beam in a cylindrical plasma column. Feit, M.D.; Fleck, J.A. Jr. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Appl. Phys. Lett.*; **28**: No. 3, 121-124(1 Feb 1976).

The laser heating of an initially uniform plasma column has been modeled in a self-consistent way, including the effects of medium magnetohydrodynamics and refraction and diffraction of the laser light. The results show that a portion of the pulse can become trapped, leading to a pattern of alternate focusing and defocusing of the beam. (AIP)

12126 Equilibrium theory of toroidal magnetic cusp confinement with internal circulation. Hammer, J.H.; Kunkel, W.B. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Fluids;* **19**: No. 3, 438-442(Mar 1976).

Plasma confined in the Tormac configuration can be made to rotate about the minor axis so that guiding-center drifts do not carry the particles to the boundary layer even in a purely toroidal field B (R). In this way the anisotropy in velocity space caused by losses at the cusps will not be rapidly communicated to the interior. Rotation can be enhanced and controlled, in principle, by neutral injection with angular momentum about the minor axis. The properties and stability characteristics of such a state are theoretically investigated in the present paper. The conditions for a stationary state are shown to require that the number of particles on a flux tube remains constant, yielding the relation n (R) R/B (R) ≅ const. The equilibrium properties of the plasma are observed with the use of two different models: (1) The plasma is treated as consisting of two fluids with negligible centrifugal effects and interspecies interactions, where electrons are considered as isotropic with the equation of state d/dt (P/sube/n^{-}/sup gamma/) =0, while the ions are anisotropic and obey the Chew—Goldberger—Low equations. (2) The plasma is treated as a single fluid with negligible centrifugal effects and scalar pressure, i.e., obeys d/dt (Pn^{-}/sup gamma/) =0. In each case the equilibrium solutions n (R) are found to be marginally interchange-stable. (AIP)

PLASMA DIAGNOSTICS

REFER ALSO TO CITATION(S) 12193

12127 (AD/A—005715) Electric arcs and seeded plasmas. Final report, 1 September 1970—31 August 1974. Benenson, D.M. (State Univ. of New York, Buffalo (USA)). 27 Dec 1974. 25p. NTIS $3.25.

Experiments and analyses, emphasizing diagnostics (local temperature distributions), have been applied to cross-flow, axial-flow, and seeded plasma configurations. Application of a unique optical system, which permits radiation from the arc to be observed simultaneously at eleven azimuthal angles about the arc column, has permitted the determination of the local temperature distribution for this non-circular (in cross-section) configuration. High speed data acquisition techniques have been applied to determine the local temperatures during the dynamic response of voltage pulsed axial-flow plasmas. The tests carried out upon the cross-flow arc have also detailed the cross-sectional shape and arc profile. (GRA)

12128 (CONF-751125—124) Software implementation of a high speed interface between a PDP-10 and several PDP-11s. De Mesa, N.P. III. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. Contract E(11-1)-3073. 11p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The DMA10 is a high speed link between a PDP-10 and up to eight PDP-11s; specifically, the PDP-10 shares sections of its memory with the PDP-11s. The two segment concept on the PDP-10 of shared/reentrant code and non-shared code is implemented. The inclusion of read only memory on the PDP-11s allows for the development of "PROM" software which all the PDP-11s may share. The principal difference between the DMA10 and other communications interfaces is that it is not a block transfer device. Because of the shared memory concept the features of the DMA10 are high data bandwidth and minimal processor intervention between data transfers. Communication programs between the PDP-10 and the PDP-11 may be tested wholly in either processor, independent of the DMA10 interface. In the current mode of operation the PDP-11's simply act as device controllers. Future plans include separate operating systems in various PDP-11s. (auth)

12129 (COO—2711-1) Extreme ultraviolet and soft x-ray diagnostics of high-temperature plasmas. Annual progress report, June 1, 1975—May 31, 1976. Moos, H.W.; Armstrong, L. Jr.; Fastie, W.G. (Johns Hopkins Univ., Baltimore, Md. (USA)). 1976. Contract E(11-1)-2711. 20p. Dep. NTIS $3.50.

The report discusses the four major research areas of this program: diagnostic studies of CTR plasmas, laboratory spectroscopy and calibration at short wavelengths, theoretical computation of transition probabilities for highly ionized atoms, and instrument development for short wavelength studies of CTR devices. Using existing instruments, diagnostic studies are under way at Versator and Elmo Bumpy Torus. A facility has been completed for the sensitivity calibration of spectrometers down to 300 A as complete units. The development of computer programs necessary for transition probability calculations is ninety percent complete. An f/20 forty cm focal length concave grating spectrometer has been constructed utilizing very high vacuum techniques to reduce contamination of plasma devices and calibration sources such as SURF II at NBS. New designs for grazing incidence monochromators have been developed.

12130 (UCRL—77075(Rev.1)) Computer analysis of four channel x-ray microscopy images to obtain source and spectral emission data on laser fusion targets. Harper, T.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Dec 1975. Contract W-7405-Eng-48. 28p. (CONF-751130—15). Dep. NTIS $4.00.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

A description is given of how data from a typical four channel microscope experiment is recorded and processed. The computer code MISE is described. Seventeen figures showing various results are given. (MOW)

12131 (SAND—76-6012) Spectroscopic study of an argon plasmajet out of local thermodynamic equilibrium. Ranson, P.; Chapelle, J. Translated by D.P. Aeschliman from *J. Quant. Spectrosc. Radiat. Transfer;* **14**: No. 1, 1-18(Jan 1974). 26p. Dep. NTIS $4.00.

The properties of an argon plasmajet seeded with a few percent of hydrogen were studied. At atmospheric pressure, significant deviations from local thermodynamic equilibrium (LTE) are shown. The plasma parameters (electron density N/sub e/, tem-

perature T) have been determined from the broadening and the absolute intensity of hydrogen lines. The transition probabilities and the broadening parameters (width and shift) of some AI lines between 4000 and 6000 A have been measured. (auth)

12132 Plasma diagnostics using laser-excited coupled and transmission ring resonators. Haas, R.A. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *J. Appl. Phys.*; **47**: No. 3, 879-885(Mar 1976).

In this paper a simple two-level laser model is used to investigate the frequency response of coupled-cavity laser interferometers. It is found that under certain circumstances, often satisfied by molecular gas lasers, the frequency response exhibits a resonant behavior. This behavior severely complicates the interpretation of coupled-cavity laser interferometer measurements of rapidly varying plasmas. To circumvent this limitation a new type of laser interferometer plasma diagnostic with significantly improved time response was developed. In this interferometer the plasma is located in one arm of a transmission ring resonator cavity that is excited by an externally positioned laser. Thus, the laser is decoupled from the interferometer cavity and the time response of the interferometer is then limited by the Q of the ring resonator cavity. This improved time response is acquired without loss of spatial resolution, but requires a more sensitive signal detector since the laser is no longer used as a detector as it is in conventional coupled-cavity laser interferometers. Thus, the new technique incorporates the speed of the Mach—Zender interferometer and the sensitivity of the coupled-cavity laser interferometer. The basic operating principles of this type of interferometer have been verified using a CO_2 laser. (AIP)

PLASMA KINETICS - GENERAL

12133 (CONF-750905—23) **Injection, compression and stability of intense ion-rings.** Sudan, R.N. (Cornell Univ., Ithaca, N.Y. (USA)). 1975. Contract AT(11-1)-3170. 23p. Dep. NTIS $3.50.

From 7. European conference on controlled fusion and plasma physics; Lausanne, Switzerland (1 Sep 1975).

Recent advances in pulsed high power ion beam technology make possible the creation of intense ion-rings with strong self-magnetic fields by single pulse injection. Such ion rings have several uses in controlled fusion e.g., to produce a min parallel B parallel magnetic geometry with a mirror ratio much higher than is possible with external conductors. For even stronger ion rings a min parallel B parallel with closed lines of force (ASTRON type) can be created. For this purpose, since the ion energies required are much higher than are available from high power sources, magnetic compression can be utilized to increase the ion energy. The success of this scheme depends critically on the stability of the ion ring. The low frequency perturbations of the ring-plasma system is examined by means of a generalization of the energy principle which established sufficient conditions for stability. The high-frequency micro-instabilities and their nonlinear consequences are discussed in terms of conventional techniques. (auth)

12134 (LBL—3399(Suppl.), pp I.5.1-I.5.5) **Large-area plasma sources.** Ehlers, K.W.; Baker, W.R.; Berkner, K.H.; Cooper, W.S.; Kunkel, W.B.; Pyle, R.V.; Stearns, J.W. (Univ. of California, Berkeley). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

High-current ion sources for neutral-beam injection into controlled-fusion experiments require large-area uniform high-density plasmas from which to extract the ions. Three types of such sources have been constructed for use with several injection experiments. All generate the plasma by a diffuse low-pressure high-current discharge from distributed thermionically emitting cathodes, without the use of externally applied magnetic fields. Two are short pulse (t = 30 and 10 msec, power, supply limited) sources from which deuterium ion-current densities of approximately 0.5 A/cm^2 are extracted from a 7- x 7-cm square array and from a 7- x 35-cm rectangular array. The third operates for 10 sec and gives a hydrogen ion-current density of 0.25 A/cm^2 over a 10-cm diameter. The design differences for long- and short-pulse operation, as well as the operating characteristics of each, will be discussed. (auth)

12135 (LBL—3399(Suppl.), pp I.7.1-I.7.4) **Design of a general purpose duoplasmatron.** Aberth, W.; Schnitzer, R.; Engesser, F.; Anbar, M. (Stanford Research Inst., Menlo Park, CA). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

A duoplasmatron ion source, capable of rapid conversion between negative and positive beam operation has been constructed. Both filament and hollow cathode arc sources are used. In addition, the source can be operated in the hollow-discharge mode, and off-axis negative ion extraction techniques can be utilized. High purity ion beams are obtained by the use of metal gasket vacuum scales in the source, careful attention to cleanliness in the gas inlet system, and the use of special techniques such as hot CuO to oxidize hydrocarbons in the sample gas. (auth)

12136 (LBL—3399(Suppl.), pp I.8.1-I.8.6) **Charge modes of pulsed high energy and high density plasma injection source.** Cheng, D.Y. (Univ. of Santa Clara, CA). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

Detonation (snowplow), deflagration and other modes of discharge can be produced in a single coaxial plasma gun. Conservation laws of mass, momentum and energy together with the entropy production condition of the discharge phenomena are used to identify dense discharge modes. The Rankine-Hugoniot relation for a magnetized plasma is derived. Discussions of how to design a deflagration plasma gun to yield a prescribed plasma kinetic energy and plasma beam density are given. (auth)

12137 (LBL—3399(Suppl.), pp II.1.1-II.1.10) **Computer-aided extractor design.** Cooper, W.S.; Halbach, K.; Magyary, S.B. (Univ. of California, Berkeley, CA). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

A computer program, WOLF is described that simulates ion extraction from a plasma and acceleration through an electrode structure and optimizes the performance of the extractor (minimizes the final beam divergence) by varying the potentials, shapes, and positions of the electrodes. WOLF also finds the self-consistent shape and position of the plasma equipotential representing the emitter. The measured performance of the slot extractors agrees well with the computed performance based on our model for the plasma if the ions are assumed to have a temperature of about 1 eV at the emitter. The most important factors affecting the beam divergence are, in decreasing order of importance, (1) gross electrostatic lens effects, including the space-charge of the ions, (2) the initial ion temperature, (3) the shape of the first, or "beam-forming," electrode, and (4) the shape and position of the plasma sheath edge, or emitter. (auth)

12138 (LBL—3399(Suppl.), pp II.2.1-II.2.4) **Computer simulation of focused ion beams.** Boers, J.E.; Freeman, J.R.; Poukey, J.W. (Sandia Labs., Albuquerque, NM). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

Two digital computer programs have been employed in the simulation of plasma expansion cups and the ion beams drawn from them. The axially symmetric ion beam is simulated with a relativistic beam program assuming that a particular plasma surface exists on the plasma expansion cup. Electrodes are employed which produce a focused ion beam at the voltage and current desired assuming space-charge-limited emission from the plasma surface. Then, boundary conditions are taken from the beam simulation near the plasma surface and used as input data for the plasma simulation program. The shape of the cup and the plasma injection rate can then be varied until the proper ion current is obtained from a surface close to that assumed in the beam program. Using this technique, deuteron beams of more than one ampere of current and source current densities in excess of 10^4 amperes per meter^2 have been simulated. (auth)

12139 (UCID—16992) **Photon-induced gas breakdown in the gas-embedded Z-pinch.** Eddleman, J.L.; Hartman, C.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1976. Contract W-7405-Eng-48. 20p. Dep. NTIS $4.00.

The breakdown of dense gas surrounding a thermonuclear temperature z-pinch is estimated. Restrictions on the pinch mass, driving electric field, and surrounding neutral gas density are obtained. (auth)

PLASMA KINETICS - EXPERIMENTAL

12140 Mega-Gauss turbulence due to seeded composition fluctuations in dense plasma, and electron beam scattering. Tidman, D.A. (Institute for Fluid Dynamics and Applied Mathematics, University of Maryland, College Park, Maryland 20742). *Phys. Fluids*; **19**: No. 2, 321-326(Feb 1976).

Fine scale variations in the chemical composition of a collision-dominated plasma give rise to corresponding spatial fluctuations in the electron density, which persist until being dispersed by diffusive or turbulent mixing. In the presence of a steep background temperature gradient these density fluctuations are expected to give rise to magnetic field fluctuations that reach the mega-Gauss range for temperatures of about a kilovolt. Using a simplified static plasma model, a spectrum is derived for the field fluctuations, together with a diffusion operator for the enhanced scattering of energetic particles in such a plasma. This phenomenon may be of interest in the design of targets for electron-beam driven fusion. (AIP)

PLASMA KINETICS - THEORETICAL

12141 (LA—5988) **Slowing-in distribution of fast particles released in Maxwellian plasma.** Husseiny, A.A.; Sabri, Z.A.; Harris, D.R. (Los Alamos Scientific Lab., N.Mex. (USA)). May 1975. Contract W-7405-Eng-36. 19p. Dep. NTIS $4.00.

The time-independent slowing-in distribution is evaluated for a fast beam of test particles released in an infinite Maxwellian plasma background for various situations including quantum-mechanical and classical scattering regimes. The analysis involves considerations of small angle deflection and large angle scattering events. The results are determined for plasma electrons with thermal velocities larger or smaller than the test particle and plasma ions with thermal velocities lower than the test particle. When plasma electrons and ions are slow the slowing-in distribution behaves as E/sub j//sup $^1/_2$/, where E/sub j/ is the test particle energy. When plasma electrons are faster than the test particles, the high-energy tail acquires a 1/E/sub j/ shape. The origin of the test particle remains arbitrary and hence the results apply for particles produced by fusion events within the plasma proper and for particles externally injected. The total energy distribution is obtained and normalized, and ranges of validity are determined. The calculations are of the Boltzmann type, which is consistent with binary scattering models. The slowing-in distributions are also obtained from the Fokker—Planck equation, and as expected, the results agree with those obtained from the Boltzmann equation for large angle scattering only. (auth)

12142 (LA—6136) **Description of collisionless plasmas by classical field equations.** Fraley, G.S. (Los Alamos Scientific Lab., N.Mex. (USA)). Oct 1975. Contract W-7405-Eng-36. 7p. Dep. NTIS $4.50.

Classical field equations are derived from quantum fields to obtain a different and possibly simpler description of a collisionless plasma. The method is to take the simultaneous limit, Dirac constant, e, m yields 0, of charged scalar fields and the electromagnetic field. Laplace transforms for perturbations in a uniform relativistic plasma are compared with corresponding results from the Maxwell—Vlasov equations. For the nonlinear case, a distribution function defined on the classical fields is shown to satisfy the Vlasov equation. (auth)

12143 (LBL—4444) **Mathematical models and algorithms for the computer program 'WOLF'.** Halbach, K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1975. Contract W-7405-Eng-48. 59p. Dep. NTIS $5.50.

The computer program FLOW finds the nonrelativistic self-consistent set of two-dimensional ion trajectories and electric fields (including space charges from ions and electrons) for a given set of initial and boundary conditions for the particles and fields. The combination of FLOW with the optimization code PISA gives the program WOLF, which finds the shape of the emitter which is consistent with the plasma forming it, and in addition varies physical characteristics such as electrode position, shapes, and potentials so that some performance characteristics are optimized. The motivation for developing these programs was the desire to design optimum ion source extractor/accelerator systems in a systematic fashion. The purpose of this report is to explain and derive the mathematical models and algorithms which approximate the real physical processes. It serves primarily to document the computer programs. 10 figures. (RWR)

12144 (MATT—1181) **Transport equations in axisymmetric toroidal coordinates.** Gralnick, S.L. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 33p. Dep. NTIS $4.00.

A derivation is presented of the conservation law form of the single energy group transport equation in an axisymmetric toroidal coordinate system formed by rotating a nest of smooth, simply closed, plane curves of arbitrary parametric description about an axis which does not intersect the nest. This general equation may be used for generating equations specific to particular cross section geometries, or as the basis of a finite difference equation for the general case. The effect of both the toroidal and poloidal curvatures of the system are investigated, and criteria for the validity of cylindrical and planar approximations are established. The diffusion equation for this geometry is derived, and it is shown to be formally homologous to the "r-theta" cylindrical diffusion equation if the coordinate system is orthogonal and if the azimuthal coordinate, phi, is ignorable. (auth)

12145 (ORNL-TM—5237) **Linearized gyro-kinetic equation.** Catto, P.J.; Tsang, K.T. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 28p. Dep. NTIS $5.00.

An ordering of the linearized Fokker-Planck equation is performed in which gyroradius corrections are retained to lowest order and the radial dependence appropriate for sheared magnetic fields is treated without resorting to a WKB technique. This description is shown to be necessary to obtain the proper radial dependence when the product of the poloidal wavenumber and the gyroradius is large (k rho much greater than 1). A like particle collision operator valid for arbitrary k rho also has been derived. In addition, neoclassical, drift, finite β (plasma pressure/magnetic pressure), and unperturbed toroidal electric field modifications are treated. (auth)

12146 (UCID—16830(Rev.1)) **VOA: a 2-d plasma physics code.** Eltgroth, P.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1975. Contract W-7405-Eng-48. 38p. Dep. NTIS $4.00.

A 2-dimensional relativistic plasma physics code was written and tested. The non-thermal components of the particle distribution functions are represented by expansion into moments in momentum space. These moments are computed directly from numerical equations. Currently three species are included - electrons, ions and "beam electrons". The computer code runs on either the 7600 or STAR machines at LLL. Both the physics and the operation of the code are discussed. (auth)

12147 (UCRL—52009) **Coupled MHD-Monte Carlo transport model for dense plasmas.** Chandler, W.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1975. Contract W-7405-Eng-48. 104p. Dep. NTIS $5.45.

Thesis.

A two-dimensional, two fluid model of the MHD equations has been coupled to a Monte Carlo transport model of high energy, non-Maxwellian ions. The MHD part of the model assumes complete ionization and includes a perfect gas law for a scalar pressure, a tensor artificial viscosity, electron and ion thermal conduction, electron-ion coupling, and a radiation loss term. A simple Ohm's Law is used with a B/sub theta/ magnetic field. The MHD equations were solved in Lagrangian coordinates. The conservation equations were differenced explicitly and the diffusion-type equations implicitly using the splitting technique. The Monte Carlo model solves the equation of motion for high energy ions, moving through and suffering small and large angle collisions with the fluid Maxwellian plasma. The source of high energy ions is the thermonuclear reactions of the hydrogen isotopes, or it may be an externally injected beam of neutralized ions. In addition to using the usual Maxwell averaged thermonuclear cross sections for calculating the number of reactions taking place within the Maxwellian plasma, the high energy ions may suffer collisions resulting in a reaction. In the Monte Carlo model all neutrons are assumed to escape, and all energetic ions of Z less than or equal to 2 are followed. (auth)

12148 **MOBILITY AND DIFFUSION OF IONS IN GASES.** McDaniel, E.W.; Mason, E.A. New York; John Wiley and Sons, Inc. (1973). 381p.

The following chapters are included: (1) measurement of drift velocities and longitudinal diffusion coefficients, (2) measurement of transverse diffusion coefficients, (3) afterglow techniques, (4) kinetic theory of diffusion and mobility, (5) interaction potentials and mobility, and (6) experimental data on mobilities and diffusion coefficients. (MOW)

12149 **Influence of self-fields on the Vlasov equilibrium and stability properties of relativistic electron beam-plasma systems.** Davidson, R.C.; Hui, B.H. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). *Ann. Phys. (N.Y.)*; **94**: No. 2, 209-242(Oct 1975).

The influence of self-fields on the equilibrium and stability properties of relativistic beam-plasma systems is studied with the framework of the Vlasov-Maxwell equations. The analysis is carried out in linear geometry, where the relativistic electron beam propagates through a background plasma (assumed nonrelativistic) along a uniform guide field B_0e/subz/. It is assumed that ν/γ_0very-much-less-than1 for the beam electrons (ν is Budker's parameter, and $\gamma_0 mc^2$ is the electron energy), but no a priori assumption is made that the beam density is small (or large) in comparison with the plasma density, or that conditions of charge neutrality or cur-

rent neutrality prevail in equilibrium. It is shown that the equilibrium selfflelectric and self-magnetic fields, E/subr/ /subs/(r) e/subr/ and B/sub theta/ /subs/(r) e/sub theta/, can have a large effect on equilibrium and stability behavior. Equilibrium properties are calculated for beam (j=b) and plasma (j=e,i) distribution functions of the form f/subb/ °(H, P/sub theta/, P/subz/) =F (H-ω/subr//subb/ P/sub theta/) xδ (P/subx/-P_0)(j=b), and f/subj/ °(H, P/sub theta/, P/subz/) =f/subj°(H-ω/subr//subj/P/sub theta/-V/subj/P/subz/ -m/subj/V/subj/ ²/2) (j=e,i), where H is the energy, P/sub theta/ is the canonical angular momentum, P/subz/ is the axial canonical momentum, and ω/subr//subj/ (the angular velocity of mean rotation for j=b,e,i), V/subj/(the mean axial velocity for J=e,i), and P_0 are constants. The linearized Vlasov-Maxwell equations are then used to investigate stability properties in circumstances where the equilibrium densities of the various components (j=b, e, i) are approximately constant. The corresponding electrostatic dispersion relation and ordinary-mode electromagnetic dispersion relation are derived (including self-field effects) for (AIP)

12150 Plasma transport theory in tokamaks. Sigmar, D.J. (Massachusetts Inst. of Tech., Cambridge). *Trans. Am. Nucl. Soc.;* 22: 267-268(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12151 One-dimensional plasma transport calculations in tokamaks. Hogan, J.T. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* 22: 268-269(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12152 Transformation of the single-energy-group transport equation to axisymmetric toroidal coordinates. Gralnick, S.L. (Princeton Plasma Physics Lab., NJ). *Trans. Am. Nucl. Soc.;* 22: 269-270(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12153 Split solution for particle transport in toroidal plasma devices. Hennart, J.P. (Universidad Nacional Autonoma de Mexico, Mexico City); Martin, J.; Sanchez, J. *Trans. Am. Nucl. Soc.;* 22: 270(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12154 Monte Carlo simulation of neutral beam injection into fusion plasmas. Miller, R.L.; Miley, G.H. (Univ. of Illinois, Urbana). *Trans. Am. Nucl. Soc.;* 22: 270-271(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12155 Theory of plasma simulation using multipole-expansion scheme. Chen, L.; Okuda, H. (Princeton Univ., NJ). *J. Comput. Phys.;* 19: No. 4, 339-352(Dec 1975).

Nonphysical grid effects in plasma simulation using the multipole-expansion scheme and Gaussian-shape charge particles are studied analytically in one dimension. General expressions for the linear dispersion relation, fluctuation spectra, energy, and momentum conservations are derived and then compared with those of the Cloud-in-Cell (ClC) scheme using cell-size clouds. The results indicate that the dipole-expansion scheme and its subtracted version have, in general, grid effects comparable to ClC. Grid effects, however, are greatly reduced in schemes keeping higher-order moments, such as the quadrupole-expansion scheme. (auth)

12156 Vlasov confinement equilibria in one dimension. Hewett, D.W.; Nielson, C.W.; Winske, D. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico). *Phys. Fluids;* 19: No. 3, 443-449(Mar 1976).

A method for constructing one-dimensional Vlasov equilibria from assumed macroscopic moments is described and examples are given. General properties of these equilibria, in particular, the fact that temperature anisotropy in the two directions perpendicular to the magnetic field is required, are discussed. Results of particle simulations which verify the validity of these equilibria and illustrate the effects of temperature anisotropy are presented. (AIP)

12157 Two-species flow in relativistic diodes near the critical field for magnetic insulation. Bergeron, K.D. (Plasma Theory Division-5241, Sandia Laboratories, Albuquerque, New Mexico 87115). *Appl. Phys. Lett.;* 28: No. 6, 306-308(15 Mar 1976).

An analysis of space-charge-limited counterstreaming flow of ions and electrons in a high-voltage planar diode in the presence of a strong transverse magnetic field is presented. A two-component one-dimensional cold-fluid model is used which includes most self-consistent effects. A substantial enhancement of ion current by a factor of 3—6 is found at fields slightly larger than the critical magnetic insulation field. (AIP)

PLASMA PRODUCTION

REFER ALSO TO CITATION(S) 11327, 11683, 11716

PLASMA INSTABILITIES

12158 (CONF-760209—12) **Impurity beam-trapping instability in tokamaks.** Hogan, J.T.; Howe, H.C. (Oak Ridge National Lab., Tenn. (USA)). 1976. 23p. Dep. NTIS $3.50.

From 2. international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America °USA° (16 Feb 1976).

The sensitivity of neutron energy production to the impurity trapping of injected neutral beams is considered. This process is affected by inherent low-Z contamination of the tritium pre-heat plasma, by the species composition of the neutral beam, and by the entrance angle of the beam. The sensitivities of the process to these variables, and to the variation of wall material are compared. One finds that successful use of a low-Z, low-sputtering material can appreciably lengthen the useful pulse length. (auth)

12159 (CONF-7509104—1) **Efforts to stabilize the M = 2 helical instability in ATC.** Bol, K.; Ellis, R.A. Jr.; Hsuan, H. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 14p. Dep. NTIS $3.50.

From Soviet-American seminar on feedback and dynamic stabilization of high temperature plasmas; Sukhuric, Union of Soviet Socialist Republics °USSR° (23 Sep 1975).

Experiments show that there is no difficulty about interacting with a 2/1 mode in ATC, and that given sufficient gain and a harmonic-free control winding the probability of stabilizing it is good. Control by steadily applied, DC quadrupole fields, on the other hand, on the basis of experiments with ATC as well as Pulsator, would seem at this juncture to have a small chance of success. Finally, the high currents achieved in gettered discharges offer the possibility that if control of wall emission can be achieved—e.g., with a divertor—one may simultaneously achieve a measure of control of the 2/1 and higher modes. (auth)

12160 (COO—1478-14) **Theoretical investigations relevant to controlled fusion research. Progress report, January 31, 1975—January 31, 1976.** Kammash, T. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). Jan 1976. Contract AT(11-1)-1478. 7p. Dep. NTIS $3.50.

The main research effort was directed at two major categories of problems associated with plasma confinement in mirror machines and tokamaks. In the latter case the emphasis was on the effect of runaway electrons on the overall stability of the system while for the open-ended devices much of the effort went into examining the impact of finite beta and feedback stabilization on loss cone modes as well as some investigations in the reactor aspects of mirror confined plasmas. The highlights of these studies along with some of the results are described. (MOW)

12161 (COO—2059-51) **Simulation of parametric instability effects in a beam plasma system.** Hubbard, R.F. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Dec 1975. 231p. Dep. NTIS $8.00.

Thesis.

An energetic electron beam produces large amplitude resonant plasma oscillations which can parametrically decay into growing nonresonant electron and ion waves if ion dynamics are included. A similar parametric instability occurs in a plasma driven by a high frequency external electric field. A two-specie particle simulation study of beam generated parametric instabilities is presented and the results compared with corresponding one-specie beam and external field simulations. For low beam densities the individual nonresonant modes grow approximately at the rates predicted by parametric instability theory. This growth eventually causes the resonant plasma oscillations to decay exponentially at a rate proportional to the original parametric growth rate. f/sub e/(v) develops suprathermal tails which eventually lead to a stable non-Maxwellian plasma with a field energy spectrum W/sub k/ approximately k^{-3} as seen in external field simulations. The velocity diffusion coefficient has been measured from test particle dynamics, and beam plasmas driven by an external field have been simulated. Also, the possible role of the parametric instability in sta-

bilizing the beam against deceleration has been studied, and the inclusion of parametric threshold effects lead to more stringent requirements for parametric stabilization than had been previously assumed. The consequences for several astrophysical and laboratory plasma systems are discussed.

12162 (LA—620-4MS) **Two-step model of scyllac equilibrium.** Miller, G. (Los Alamos Scientific Lab., N.Mex. (USA)). Jan 1976. Contract W-7405-Eng-36. 8p. Dep. NTIS $4.50.

The simplest sharp boundary MHD equilibrium theory of Scyllac, assuming nearly cylindrical geometry, is extended to a two-step plasma beta profile. Generalizations of the standard equilibrium formulas are given. (auth)

12163 (MATT—1157) **Upper hybrid solitons and oscillating-two-steam instabilities.** Porkolab, M.; Goldman, M.V. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 48p. Dep. NTIS $4.00.

A warm two-fluid theory of soliton formation near the upper-hybrid frequency is developed. Several forms of the nonlinear Schroedinger equation are obtained, depending on whether the electric field is completely perpendicular to the dc magnetic field or whether it has an additional small component parallel to the magnetic field. For the perpendicular case, the character of the soliton depends on its scale length, L, and on β. For low β, when L is less than c/ω/sub pe/, one finds stationary envelope and hole solitons, whereas when L is greater than c/ω/sub pi/ we obtain the super-Alfvenic solitons described by Kaufman and Stenflow by MHD theory. However, the case E/sub parallel/ not equal to 0 may be of more interest, since it couples the pump to the excited waves more efficiently. In the limit of linearization about an infinite wavelength pump, the nonlinear Schroedinger equations yield purely growing (oscillating-two-stream) instabilities in both cases. (auth)

12164 (MATT—1208) **Filamentation instability of lower hybrid waves in a plasma.** Kaw, P.K. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Feb 1976. Contract E(11-1)-3073. 12p. Dep. NTIS $3.50.

It is shown that a strong lower hybrid wave is modulationally unstable to perturbations propagating along its own wave vector. The instability relies critically on the finite thermal corrections to the lower hybrid dispersion relation. (auth)

12165 (UCI—75-14) **Filamentary instabilities of rotating electron beams.** Molvig, K.; Benford, G.; Condit, W.C. Jr. (California Univ., Irvine (USA). Dept. of Physics; California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. Contract AT(04-3)-34. 46p. Dep. NTIS $4.00.

A rotating, relativistic electron beam is highly unstable if its net current is neutralized by a background plasma. The beam breaks up into a series of concentric doughnuts (ring tearing). The external magnetic field cannot inhibit this k = k/sub z/ perturbation. Growth rates are calculated in the thin beam approximation. Numerical simulations bear out the linear growth times. Growth saturates when the relativistic electrons are sufficiently thermalized to satisfy a pinch equilibrium condition and they oscillate in the magnetic wells formed by the field perturbations. An additional feature of the mode in this geometry is a radial electrostatic field which is necessary to drive the cross-field current.

12166 (UCI—75-41) **Surface filamentation of a relativistic electron beam in a plasma.** Molvig, K.; Roberson, C.W. (California Univ., Irvine (USA). Dept. of Physics). 1975. Contract AT(04-3)34. 21p. Dep. NTIS $3.50.

The electromagnetic instability of a relativistic electron beam in a plasma that is current and charge neutralized in the beam channel. In addition to the usual filamentary instability one finds an instability that is localized to the surface of the beam. The large azimuthal mode number growth rate in cylindrical geometry is ω/sub i/ = ω/sub b// radical 2γ. The effects of collisions, a conducting wall, magnetic field, hollow beam geometry and different plasma densities, inside and outside the beam, are calculated.

12167 Parametric instabilities in strongly relativistic, plane-polarized electromagnetic waves. Drake, J.F.; Lee, Y.C.; Tsintsadze, N.L. (Department of Physics, University of California, Los Angeles, California 90024). *Phys. Rev. Lett.*; **36**: No. 1, 31-34(5 Jan 1976).

We investigate the stability of long-wavelength, plane-polarized electromagnetic waves when the oscillatory energy of the electrons exceeds their rest energy. The strong electron-mass variation destabilizes electron modes polarized along the electric field of the pump E_0. The electron and ion modes decouple in the presence of such an intense pump and hence the ions do not strongly influence the instability. (AIP)

12168 Explosive instability of drift-cone modes in mirror machines. Liu, C.S.; Aamodt, R.E. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Phys. Rev. Lett.*; **36**: No. 2, 95-98(12 Jan 1976).

We examine the parametric coupling of the negative-energy drift-cone mode near the ion-cyclotron frequency with lower-frequency positive-energy modes through the electronic nonlinearity. This parametric process is shown to be stabilized by azimuthal asymmetry occurring in the early stage of the buildup. The theory is compared with the experimental observations. (AIP)

12169 Ion-cyclotron waves in nonuniform plasmas and parametric instabilities. Sperling, J.L.; Perkins, F.W. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). *Phys. Fluids;* **19**: No. 2, 281-292(Feb 1976).

A general formalism for studying waves propagating in a plasma with density and magnetic field gradients in slab geometry is discussed. Specializing to electrostatic ion-cyclotron waves propagating perpendicular to the gradients, it is shown that a density profile can lead to local or nonlocal structure around points where N′ (x)/N (x) has a local maximum while inhomogeneous magnetic fields provide the wave with the profile of an Airy function. Application of the formalism to parametric instabilities driven by magnetosonic waves and with k/suby/rho/subi/very-much-greater-than1 is discussed. In particular, it is concluded that density and magnetic field gradients should not be critical in the development of the cyclotron decay instability in the FM-1 (floating multipole-1), ATC (adiabatic toroidal compressor), and PLT (Princeton large torus) devices of Princeton. (AIP)

12170 Energy lost by a relativistic electron beam due to two-stream instability. Thode, L.E. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Fluids;* **19**: No. 2, 305-315(Feb 1976).

The two-stream instability between a monoenergetic relativistic electron beam of energy $\gamma_0 mc^2$ and density n/subb/ and an unmagnetized, homogeneous plasma of density n/sube/ is investigated. For weak interactions, $S=\beta^3_0\gamma_0(n/subb//2n/sube/)^{1/3}<0.45$, the two-stream spectrum is predominantly one-dimensional, and the fractional beam energy loss is $\Delta E=S\ (1+S)^{-3/2}$. However, for strong interactions, S>0.45, efficient coupling occurs to waves with perpendicular wavenumbers 0>k/sub perpendicular/< $(n/subb//n/sube/)^{1/3}$ ω/sube//c. Independent of S $\Delta E\approx 0.18$ for strong interactions. The analysis is supported by one- and two-dimensional computer simulations. In addition, it is observed that nonlinear wave particle interactions lead to rapid heating of the plasma in two-dimensional space. Symmetric bulk heating and high energy tail formation of plasma electrons is observed perpendicular to the beam direction. Plasma heating parallel to the beam is asymmetric (v>0), since the large amplitude waves are generated as a result of beam trapping in the forward direction. (AIP)

12171 Energy lost by a relativistic electron beam propagating along an external magnetic field. Thode, L.E.; Godfrey, B.B. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Fluids;* **19**: No. 2, 316-320(Feb 1976).

The nonlinear interaction between a relativistic electron beam and a homogeneous, magnetized plasma is discussed. The plasma heating as a function of guide magnetic field strength is obtained by comparing three two-dimensional, fully electromagnetic numerical simulations. The interaction involves a $(\gamma_0-1)mc^2=1.5$ meV monoenergetic beam with a beam-to-plasma density ratio of n/subb//n/sube/10 $^{-3}$ The zero and moderate magnetic field interactions are strongly two-timensional in character, in agreement with theory. The strong magnetic field case is similar to a one-dimensional interaction. The presence of the magnetic field appears to reduce high energy tail formation perpendicular to the beam. Nonlinear Landau damping is observed to be an important process in two-dimensional space. (AIP)

12172 Thresholds of parametric instabilities near the lower-hybrid frequency. Berger, R.L.; Perkins, F.W. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). *Phys. Fluids;* **19**: No. 3, 406-411(Mar 1976).

Resonant decay instabilities of a pump wave with frequency ω_0 near the lower-hybrid frequency θ/subl//subh/ are analyzed with respect to the wavenumber k of the decay waves and the ratio ω_0/ω/subl//subh/ to determine the decay process with the minimum threshold. It was found that the lowest thresholds are for decay into an electron plasma (lower-hybrid) wave plus either a backward ion-cyclotron wave, an ion Bernstein wave, or a low-frequency sound wave. For $\omega_0 <$ $(2\omega/subl//subh/)^{1/2}$, it was found that these decay processes can occur and have faster growth than ion quasi-modes provided the drift velocity (cE_0/B_0) is much less than the sound speed. In many cases of interest, electromagnetic corrections to the lower-hybrid wave rule out decay into all but

short wavelength (krho/subi/ >1) waves. The experimental results are consistent with the linear theory of parametric instabilities in a homogeneous plasma. (AIP)

PLASMA WAVE PHENOMENA

REFER ALSO TO CITATION(S) 12163, 12164

12173 (AD/A—006461) **A large quiescent magnetized plasma for wave studies.** Gekelman, W.; Stenzel, R.L. (California Univ., Los Angeles (USA). Plasma Physics Group). Dec 1974. 42p. (PPG—194). NTIS $3.75.

The development of a large magnetized plasma for wave propagation experiments is described. The method employs a dc discharge in a weak magnetic field region and subsequent particle diffusion into a strong uniform B-field region. Plasma diagnostics with probes, microwaves, and spectroscopy for steady state and afterglow are described. Examples of wave propagation for ion acoustic waves, electron Bernstein waves and lower hybrid waves indicate the versatility of the device. (GRA)

12174 (LBL—3291) **Theoretical studies of some nonlinear laser-plasma interactions.** Cohen, B.I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 15 Aug 1975. Contract W-7405-Eng-48. 214p. Dep. NTIS $7.75.

Thesis.

The nonlinear coupling of intense, monochromatic, electromagnetic radiation with plasma is considered in a number of special cases. The first part of the thesis serves as an introduction to three-wave interactions. A general formulation of the stimulated scattering of transverse waves by longitudinal modes in a warm, unmagnetized, uniform plasma is constructed. A general dispersion relation is derived that describes Raman and Brillouin scattering, modulational instability, and induced Thomson scattering. Raman scattering (the scattering of a photon into another photon and an electron plasma wave) is investigated as a possible plasma heating scheme. Analytic theory complemented by computer simulation is presented describing the nonlinear mode coupling of laser light with small and large amplitude, resonantly excited electron plasma waves. The simulated scattering of a coherent electromagnetic wave by low frequency density perturbations in homogeneous plasma is discussed. A composite picture of the linear dispersion relations for filamentation and Brillouin scattering is constructed. The absolute instability of Brillouin weak and strong coupling by analytic and numerical means is described. (auth)

12175 (MATT—1196) **Experimental studies of lower hybrid wave propagation.** Bellan, P.; Porkolab, M. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jan 1976. Contract E(11-1)-3073. 42p. Dep. NTIS $4.00.

Experimental measurements of the dispersion and damping of externally excited lower hybrid waves are presented. A multiple-ring slow-wave antenna, having 2π/k/sub z/ = 23 cm, is used to excite these waves in the Princeton L3 or L4 linear devices (B = 0.5 — 2.8 kG uniform to +- 1 percent for 1.6 m, n approximately 10^{13}, T/sub e/ approximately 3-5 eV, T/sub i/ less than or equal to 0.1 eV, He gas, plasma diameter approximately 10 cm). The waves are localized in a spatial wave packet that propagates into the plasma along a conical trajectory which makes a small angle with respect to the confining magnetic field. Measurements of the dependence of wavelength on frequency are in good agreement with the cold plasma dispersion relation. Measured values of the wave damping are in good agreement with Landau damping by the combination of the main body of the electron distribution and a approximately 30 percent high energy (T/sub e/ approximately 15-30 eV) electron tail. (auth)

12176 (MATT—1211) **Excitation of fast waves by slow waves near the lower-hybrid frequency.** Berger, R.L.; Chen, L. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Feb 1976. Contract E(11-1)-3073. 9p. Dep. NTIS $4.00.

Resonant and non-resonant decays of short wavelength lower hybrid waves into long wave-length whistler waves and ion acoustic waves are considered. It is shown that the dominant coupling to the ion acoustic mode arises from the magnetic force producing a pressure variation along the magnetic field lines. The growth rate and the threshold condition for this decay instability compare favorably with other decay instabilities near the lower-hybrid frequency. (auth)

12177 (UCI—75-45) **Excitation of ion cyclotron harmonic waves with an ion beam of high perpendicular energy.** Boehmer, H. (California Univ., Irvine (USA). Dept. of Physics). 1974. Contract AT(04-3)-34. 18p. Dep. NTIS $3.50.

Preliminary experimental results are reported on the interaction of a rotating ion beam with a plasma in an external magnetic field. The predominant feature is that the beam ions have an energy component perpendicular to the magnetic field which is large compared to the energy of the background plasma ions. It is shown that the interaction leads to the excitation of ion cyclotron harmonic waves.

12178 **Toeplitz matrix application: a dipole in a warm plasma.** Lytle, R.J.; Lager, D.L. (Univ. of California, Livermore). *Radio Sci.;* **10**: No. 10, 905-909(Oct 1975).

A linear dipole antenna has an impedance matrix of Toeplitz form. The problem of an acoustically long cylindrical antenna in a warm plasma thus becomes numerically tractable. Both the electromagnetic and acoustic wavelengths are evident in the current distribution for acoustically long antennas. Relative accuracies of 10^{-11} were obtained for inversion of a 5000 x 5000 complex impedance matrix, including both electromagnetic and acoustic contributions. Antennas up to 500 acoustic wavelengths long are considered in numerical examples. (auth)

12179 **Breaking of large-amplitude waves as a result of relativistic electron-mass variation.** Drake, J.F.; Lee, Y.C.; Nishikawa, K.; Tsintsadze, N.L. (Department of Physics, University of California, Los Angeles, California 90024). *Phys. Rev. Lett.;* **36**: No. 4, 196-200(26 Jan 1976).

The role of the relativistic electron-mass variation in the evolution of large-amplitude electromagnetic waves near the cutoff and in the generation of plasma waves by linear mode conversion is investigated. Shock formation and subsequent wave breaking along the electric field of the wave will enhance the absorption of the wave by the plasma. (AIP)

12180 **Excitation of the ordinary electromagnetic mode in low-β plasmas.** Freund, H.P.; Wu, C.S. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Phys. Fluids;* **19**: No. 2, 299-304(Feb 1976).

The excitation of the ordinary mode propagating perpendicular to an external magnetic field in a plasma with low β/sub parallel/ is discussed. The analysis is performed for plasma in which in addition to the thermal electrons there is a hot anisotropic electron component. Relativistic effects are taken into account in the stability analysis. Both a ring distribution and a loss cone distribution are used to model the hot electron species. For the ring distribution typical growth rates are larger than that for the case of the loss cone distribution. Excitation of the ordinary mode is found at numerous harmonics of the cyclotron frequency for the ring distribution, however, the loss cone distribution is found to give instability primarily at the fundamental harmonic. (AIP)

12181 **Shear induced growth and damping of waves.** Manheimer, W.M. (Naval Research Laboratory, Washington, D.C. 20375). *Phys. Fluids;* **19**: No. 2, 335-337(Feb 1976).

It is shown very simply with a time domain analysis that shear always stabilizes positive or negative energy waves. If the mode energy changes sign as a function of position, however, shear may destabilize the wave. (AIP)

THERMONUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 10382, 11051

12182 (BNL—20731) **Systems studies of dual purpose electric/synthetic fuels fusion plants.** Beardsworth, E.; Powell, J. (Brookhaven National Lab., Upton, N.Y. (USA)). Feb 1975. 53p. (CONF-750607—40). Dep. NTIS $4.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

A reactor power plant is proposed that can meet base load electrical demand, while the remainder can generate synthetic fuels and meet intermittent electrical demands. Two principal objectives of this study are: (1) to examine how strongly various economic demand and resource factors affect the amount of installed CTR capacity, and (2) to examine what increase in CTR capacity can be expected with dual purpose electric/synthetic fuel fusion plants, and also the relative importance of the different production modes. (MOW)

12183 (CONF-760207—1) **Tokamak Fusion Test Reactor experiment.** Furth, H.P. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1976. 4p. Dep. NTIS $3.50.

From Annual meeting of APS; New York, New York, United States of America "USA" (2 Feb 1976).

A brief review of the TFTR is given in terms of the physical size of the experiment in relation to existing and future tokamaks. Some break-even criteria are mentioned. (MOW)

12184 (CONF-760209—7) **ISX: a tokamak for surface and impurities studies.** Colchin, R.J.; Jernigan, T.C. (Oak Ridge National Lab., Tenn. (USA)). 1976. 22p. Dep. NTIS $3.50.

From 2. international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America 'USA' (16 Feb 1976).

The ISX (Impurity Study Experiment) is a moderate size tokamak slightly larger than the ORMAK tokamak. ISX is being built explicitly for the study of impurities and plasma-wall interactions. It is scheduled to begin experiments in the spring of 1977. Several features have been deliberately designed into the ISX which make it particularly adaptable to surface studies. The first is a welded stainless steel vacuum system, bakeable to 400°C, with a projected base pressure greater than or equal to 2×10^{-9} torr. Another feature is that of "easy" demountability of the vacuum system. Replacement of the entire vacuum system should take about two weeks. A third feature is diagnostic access to the edges of the plasma. The initial surface physics question to be answered is how best to keep surfaces clean: by baking, by direct or indirect wall bombardment discharges, or by gettering. Later experiments will involve using wall materials other than stainless steel to determine their effects on the plasma. (auth)

12185 (ERDA—76-34) **Fusion power research and development. Summary report on magnetic confinement experiments.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Controlled Thermonuclear Research). Jan 1976. 78p. Dep. NTIS $5.00.

The report is divided into five sections which discuss, respectively, Tokamaks, Theta Pinches, Mirrors, Z Pinches, and Elmo Bumpy Torus. Each section contains a brief introduction to the general principles of the confinement concept together with a discussion of the relevant machine and plasma parameters. The overview is followed by a description of each device including the name of the device, the laboratory, the principal investigator, the DCTR contact, a brief discussion of the nature and purpose of the device, the machine and plasma parameters, and the major results of the device. Finally, a summary table of parameters is provided.

12186 (GA-A—13661) **Characteristics of a first generation commercial fusion power plant.** Baker, C.C.; Harder, C.R.; Sager, P.H. Jr. (General Atomic Co., San Diego, Calif. (USA)). 11 Dec 1975. Contract E(04-3)-167. 30p. Dep. NTIS $4.00.

A brief survey was made to identify the major design parameters and features of a first generation commercial fusion plant using a noncircular tokamak reactor. This study was made to provide a frame of reference for developing a conceptual design of a demonstration plant which is intended to demonstrate the principal features of a commercial plant on a scalable basis. Based on a review of size trends in the utility industry, the plant was sized to produce about 2200 MW(e) gross output. Allowing for expected parasitic power requirements, the net station output is approximately 1800 MW(e). The plant is described in some detail. (MOW)

12187 (LA—6203-MS) **Ohmically heated high-density Z pinch.** Hammel, J.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Jan 1976. Contract W-7405-Eng-36. 5p. Dep. NTIS $4.50.

The gross properties of a high-density (n approximately equal to 10^{17} m^{-3}), small-radius, ($r = 10^{-4}$ m) gas-imbedded Z pinch have been examined considering only classical processes. The rate equation using only ohmic heating along with bremsstrahlung and radial heat transport shows that ohmic heating will rapidly take the pinch to thermonuclear temperatures for currents, I, greater than 1 MA. The radial heat loss for the pinch is very small for I greater than 1.5 MA. This suggests that the pinch could tolerate being driven to a nearby wall by an $m = 1$ kink. The laser technology for initiation of the small-diameter filament and the high-voltage technology for giving a 30-ns rise to a MA or more are available now. Some reactor considerations have been included. (auth)

12188 (MATT—1201) **Effects of low Z impurities during the startup phase of a large tokamak.** Hawryluk, R.J.; Schmidt, J.A. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jan 1976. Contract E(11-1)-3073. 20p. Dep. NTIS $4.00.

The requirements placed on a tokamak ohmic heating system (i.e. loop voltage) to initiate the plasma become more severe as the size increases because of the current density decrease. During the startup phase even small concentrations of low Z impurities can affect the plasma energy balance very substantially and have very important effects on the evolution of the discharge. The startup phase has been studied using a simple zero dimensional computer code. Because the dominant energy loss mechanisms during startup, radiation, and ionization are a volume effect, the zero dimensional code was adequate to treat this phase. The results of this study which have been applied to TFTR indicate that the plasma evolution is a sensitive function of the applied loop voltage, impurity concentration, initial filling pressure and the manner in which gas is fed into the discharge. (auth)

12189 (ORNL/TM—5280) **Suggestions for an updated fusion power program.** Clarke, J.F. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 20p. Dep. NTIS $5.00.

This document contains suggestions for a revised CTR Program strategy which should allow us to achieve equivalent goals while operating within the above constraints. The revised program is designed around three major facilities. The first is an upgrading of the present TFTR facility which will provide a demonstration of the generation of tens of megawatts electric equivalent originally envisioned for the 1985 EPR. The second device is the TTAP which will allow the integration and optimization of the plasma physics results obtained from the next generation of plasma physics experiments. The improvement in tokamak reactor operation resulting from this optimization of fusion plasma performance will enable an EPR to be designed which will produce several hundred megawatts of electric power by 1990. This will move the fusion program much closer to its goal of commercial fusion power by the turn of the century. In addition to this function the TTAP will serve as a prototype of the 1990 EPR system, thus making more certain the successful operation of this device. The third element of this revised program is an intense radiation damage facility which will provide the radiation damage information necessary for the EPR and subsequent fusion reactor facilities. The sum total of experience gained from reacting plasma experiments on TFTR, reactor grade plasma optimization and technological prototyping on TTAP, and end of life radiation damage results from the intense neutron facility will solve all of the presently foreseen problems associated with a tokamak fusion power reactor except those associated with the external nuclear systems. These external system problems such as tritium breeding and optimal power recovery can be developed in parallel on the 1990 EPR. (auth)

12190 (SAND—76-5203) **Engineering concepts in fusion.** Yonas, G. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 18p. (CONF-760215—2). Dep. NTIS $3.50.

From 16. annual ASME symposium on energy alternatives; Albuquerque, New Mexico, United States of America 'USA' (26 Feb 1976).

The major approaches to controlled fusion are described. Some of the engineering concepts involved with each approach are outlined. (MOW)

12191 (UCID—17022) **Progress on the reference mirror fusion reactor design.** Carlson, G.A.; Doggett, J.N.; Moir, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Feb 1976. Contract W-7405-Eng-48. 7p. Dep. NTIS $4.00.

The design of a reference mirror fusion reactor is underway at Lawrence Livermore Laboratory. The reactor, rated at about 900 MWe, features steady-state operation, an absence of plasma impurity problems, and good accessibility for blanket maintenance. It is concluded that a mirror reactor appears workable, but its $/kWe cost will be considerably higher than present-day nuclear costs. The cost would be reduced most markedly by an increase in plasma Q. (auth)

12192 (UCRL—51874) **Astron Program final report.** Briggs, R.J.; Hester, R.E.; Porter, G.D.; Sherwood, W.A.; Spoerlein, R.; Stallard, B.W.; Taska, J.; Weiss, P.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Aug 1975. Contract W-7405-Eng-48. 99p. Dep. NTIS $5.45.

This report describes important experimental results obtained in the last two years of the Astron Program, an LLL controlled nuclear fusion program which terminated in 1973. Little theoretical work is included, but an extensive bibliography is given. (auth)

12193 (UCRL—52000-75-12) **Energy and technology review.** Carr, R.B. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1975. Contract W-7405-Eng-48. 29p. Dep. NTIS $4.00.

Brief discussions are given on research work at the National CTR Computer Center at Livermore, high-field superconducting magnets for fusion reactors, and digital image processing for plasma diagnostics. Some developmental work on multifilamentary superconductors of Nb—Ti and Nb—Sn is described. Some complex mathematical techniques for enhancing and restoring digital images for plasma diagnostics are discussed. (MOW)

12194 (UCRL—52008) **Status report on mirror alternatives.** Condit, W.C.; Fowler, T.K.; Post, R.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Feb 1976. Contract W-7405-Eng-48. 56p. Dep. NTIS $4.50.

The present status of studies at Lawrence Livermore Laboratory (LLL) directed toward exploring variants on the basic magnetic mirror confinement concept is described. These studies have emphasized those ideas that could lead most directly to improvements in the scientific and economic viability of fusion reactors based on the mirror concept, within the general context of the extensive body of specialized physics and technology that has been developed in the course of the Mirror Program. (auth)

12195 (UWFDM—68(Vol.1)) UWMAK-I: a Wisconsin toroidal fusion reactor design. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). 20 Nov 1975. 767p. Univ. of Wisconsin, Madison, WI.

The design details of a low-β, D-T fusion reactor based on the Tokamak concept is discussed. Various technological problems are discussed. The thermal power output of the plant is 5000 MW. The basic structural material is 316 stainless steel and the heat transfer medium is lithium. Materials compatibility limits the maximum temperature to 500°C implying an electrical output of approximately 1500 MW(e) is to be expected. (MOW)

12196 (UWFDM—112) UWMAK-II: a conceptual tokamak reactor design. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Oct 1975. 659p. Univ. of Wisconsin, Madison, WI.

This report describes the conceptual design of a Tokamak fusion power reactor, UWMAK-II. The aim of this study is to perform a self consistent and thorough analysis of a probable future fusion power reactor in order to assess the technological problems posed by such a system and to examine feasible solutions. UWMAK-II is a conceptual Tokamak fusion reactor designed to deliver 1716 MWe continuously and to generate 5000 MW(th) during the plasma burn. The structural material is 316 stainless steel and the primary coolant is helium. UWMAK-II is a low aspect ratio, low field design and includes a double null, axisymmetric poloidal field divertor for impurity control. In addition, a carbon curtain, made of two dimensional woven carbon fiber, is mounted on the first vacuum chamber wall to protect the plasma from high Z impurities and to protect the first wall from erosion by charged particle bombardment. The blanket is designed to minimize the inventory of both tritium and lithium while achieving a breeding ratio greater than one. This has led to a blanket design based on the use of a solid breeding material ($LiAlO_2$) with beryllium as a neutron multiplier. The lithium is enriched to 90 percent ^6Li and the blanket coolant is helium at a maximum pressure of 750 psia (5.2×10^6 N/m^2). A cell of the UWMAK-II blanket design is shown. The breeding ratio is between 1.11 and 1.19 based on one-dimensional discrete ordinates transport calculations, depending on the method of homogenization. Detailed Monte Carlo calculations, which take into account the more complicated geometry, give a breeding ratio of 1.06. The total energy per fusion is 21.56 MeV, which is fairly high. (auth)

12197 Global plasma models for tokamak engineering studies. Stacey, W.M. Jr. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; 22: 267(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12198 Optimizing the mirror (fusion—fission) hybrid reactor for plutonium production. Lee, J.D.; Bender, D.J.; Moir, R.W. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.*; 22: 11-12(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12199 Possibilities of the fusion—fission hybrid concept in the context of the overall DCTR goals. Nichols, S.P.; Vanston, J.H. Jr. (Univ. of Texas, Austin). *Trans. Am. Nucl. Soc.*; 22: 13-14(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12200 Implications to the CTR community of standardization in nuclear analysis codes. Bosler, G.E. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.*; 22: 39-40(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12201 Mirror fusion reactor study. Carlson, G.A.; Moir, R.W. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.*; 22: 59(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12202 Preliminary design aspects of the UWMAK-III conceptual tokamak power reactor. Conn, R.W.; Kulcinski, G.L.; Maynard, C.W. (Univ. of Wisconsin, Madison). *Trans. Am. Nucl. Soc.*; 22: 59-60(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12203 Global reactor parameter survey for elliptical cross-section tokamaks with large power ratings. Usher, J.L.; Powell, J.R. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.*; 22: 60-61(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

PHYSICS AND BLANKET ENGINEERING

12204 (ORNL/TM—5035) Neutronic scoping studies for the tokamak experimental power reactor. Santoro, R.T.; Bettis, E.S.; McAlees, D.G.; Watts, H.L.; Williams, M.L. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 29p. Dep. NTIS $5.00.

One-dimensional neutron and photon radiation transport methods have been used to investigate candidate blanket configurations and compositions for use in the Tokamak Experimental Power Reactor. Seven blanket designs are compared in terms of energy recovery, radiation attenuation, potential radiation damage, and, where applicable, tritium breeding. (auth)

12205 Blanket neutronics analysis for UWMAK-III. Maynard, C.W.; Conn, R.W.; Gohar, Y. (Univ. of Wisconsin, Madison). *Trans. Am. Nucl. Soc.*; 22: 16-17(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12206 Neutronic scoping studies for a tokamak experimental power reactor. Santoro, R.T.; Bettis, E.S.; McAlees, D.G.; Watts, H.L.; Williams, M.L. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; 22: 17-18(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12207 Blanket/shield system for the ANL-TEPR preliminary conceptual design. Abdou, M.A. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; 22: 18-19(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12208 Thermal design aspects of steady-state graphite blanket concepts. Fillo, J.A.; Powell, J.R. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.*; 22: 21(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12209 Gas-carried Li_2O cooling/breeding fusion reactor blanket concept. Sze, D.K.; Larsen, E.M.; Cheng, E.T.; Clemmer, R.G. (Univ. of Wisconsin, Madison). *Trans. Am. Nucl. Soc.*; 22: 21-22(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12210 Influence of structural materials on fusion reactor blanket response. Williams, M.L.; Santoro, R.T.; Gabriel, T.A. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; 22: 40-42(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12211 Nucleonic design sensitivity analysis of the Reference Theta-Pinch Reactor (RTPR). Simmons, E.L. (Howard Univ., Washington, DC); Dudziak, D.J.; Gerstl, S.A.W. *Trans. Am. Nucl. Soc.*; 22: 43-44(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12212 Application of variational interpolation method to fusion reactor blanket studies. Cheng, E.T.; Conn, R.W. (Univ. of Wisconsin, Madison). *Trans. Am. Nucl. Soc.*; 22: 44-45(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12213 Alternatives to beryllium for neutron multiplication for solid CTR blankets. Lazareth, O.W.; Powell, J.R. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.*; **22**: 45-46(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12214 Are lithium resources adequate for energy self-sufficiency. Vine, J.D. (Geological Survey, Denver). *Trans. Am. Nucl. Soc.*; **22**: 55-56(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12215 Poloidal structure of the dissipative trapped electron drift instability. Liewer, P.C.; Manheimer, W.M.; Tang, W.M. (Naval Research Laboratory, Washington, D.C. 20375). *Phys. Fluids*; **19**: No. 2, 276-280(Feb 1976).

A study of the poloidal mode structure of the dissipative trapped electron drift mode by Fourier analysis shows that when ion inertia effects are small compared with trapped electron effects, the mode balloons out in the region of trapped particles. When ion inertia effects are large, there is no ballooning and the growth rates are correspondingly smaller. (AIP)

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 12193

12216 (CONF-751125—106) **PDX vacuum vessel stress analysis.** Nikodem, Z.D. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 9p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A stress analysis of PDX vacuum vessel is described and the summary of results is presented. The vacuum vessel is treated as a toroidal shell of revolution subjected to an internal vacuum. The critical buckling pressure is calculated. The effects of the geometrical discontinuity at the juncture of toroidal shell head and cylindrical outside wall, and the concavity of the cylindrical wall are examined. An effect of the poloidal field coil supports and the vessel outside supports on the stress distribution in the vacuum vessel is determined. A method evaluating the influence of circular ports in the vessel wall on the stress level in the vessel is outlined. (auth)

12217 (CONF-751125—107) **PDX toroidal field coils stress analysis.** Nikodem, Z.D.; Smith, R.A. (Princeton Univ., N.J. (USA). Plasma Physics Lab.; Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1975. 4p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A method used in the stress analysis of the PDX toroidal field coil is developed. A multilayer coil design of arbitrary dimensions in the shape of either a circle or an oval is considered. The analytical model of the coil and the supporting coil case with connections to the main support structure is analyzed using the finite element technique. The three dimensional magnetic fields and the non-uniform body forces which are a loading condition on a coil due to toroidal and poloidal fields are calculated. The method of analysis permits rapid and economic evaluations of design changes in coil geometry as well as in coil support structures. Some results pertinent to the design evolution and their comparison are discussed. The results of the detailed stress analysis of the final coil design due to toroidal field, poloidal field and temperature loads are presented. (auth)

12218 (CONF-751125—123) **Silver brazing methods for joining the OH and SF field coil turns for the PLT machine.** Bahr, M.W.G.; Heitzenroeder, P.J. Jr.; Johnson, H.G. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 5p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This paper describes the techniques, materials, and equipment used to silver-braze the OH and SF field coils in-place in the PLT machine. (auth)

12219 (CONF-751125—126) **Magnetic field from arbitrarily shaped flat coils with filamentary, ribbon, and rectangular cross sections.** Weissenburger, D.W.; Christensen, U.R. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 7p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This report describes the derivation of three groups of equations: (1) Field components from an arbitrarily shaped filament lying in a plane. (2) Field components from an arbitrarily shaped ribbon of infinitesimal thickness with center line lying in a plane. (3) Field components from an arbitrarily shaped bar of rectangular cross section with its center line lying in a plane. In all three cases analytical expressions for the field components were found for an infinitesimal element of the cross section. These expressions are then integrated numerically along the arbitrarily shaped center line of the coil to obtain the three field components. As a check for accuracy the calculated field values of an elliptically shaped coil were compared to an existing analytic expression for a filamentary elliptical coil. (auth)

12220 (ORNL/TM—5114) **Influence of the minor periodicity on magnetic island formation in tokamaks.** Matsuda, S. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 27p. Dep. NTIS $5.00.

This report describes the formation of magnetic islands due to external error fields. In particular, magnetic fields due to the Ohmic heating and vertical field coils that appear at the shell gaps make islands of significant size. Moreover, the toroidal minor periodicity of these perturbation fields, which is generally represented by the number of shell gaps, has an important meaning for suppression of the resonant magnetic islands. (auth)

12221 (ORNL-TM—5184) **Letter report for the superconducting magnet development program (Number 4). Progress report, June 1, 1975—September 1, 1975.** (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 36p. Dep. NTIS $5.00.

The program objectives are outlined. Brief discussions of research progress are given for the following: systems design, coil design, conductor selection and test, radiation effects, coil protection, structural analysis and material tests, cryogenics and refrigeration, coil fabrication, and coil test and evaluation. (MOW)

12222 Thermal excursions of large superconducting magnets. Botts, T.E.; Frederking, T.H.K. (Univ. of California, Los Angeles). *Trans. Am. Nucl. Soc.*; **22**: 50-51(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12223 Structural endurance constraints for high-field theta-pinch coils. Bartholomew, R.J.; Krakowski, R.A.; Hagenson, R.L. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.*; **22**: 20-21(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

POWER SUPPLIES AND CIRCUITRY

12224 (CONF-751125—115) **Pulsed power liner for PLT energy systems.** Armellino, C.A.; Bronner, G.; Murray, J.G. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 5p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

PLT is Princeton University's latest Tokamak machine in the controlled thermonuclear fusion research effort. The OH (ohmic heating) and SF (shaping field) systems for the machine place a very high energy pulsed current load on the AC line feeding them. This paper describes the two systems and the steps taken to insure minimum effect on line regulation during the pulsed operation. (auth)

12225 (MATT—1179) **Fault protection for neutral-beam injection systems.** Knauer, R.C.; Ashcroft, D.L.; Murray, J.G.; Newman, R.A. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 13p. (CONF-751125—117). Dep. NTIS $4.00.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This paper discusses the accelerating, or main supply for the Neutral Injection System on PLT and, in particular, provides evaluation of a system for protection against the possibility of an arc developing in the accel portion of the ion source gun. The design of a protection scheme utilizing a fast turn-on and turn-off ignitron crowbar is described and evaluated. This crowbar is used to provide backup protection for the ion source high power vacuum tube used as a voltage regulator and series switch. Ignitron crowbars are proposed for use as primary protection of the 150 KV ion source being developed for the Tokamak Fusion Test Reactor (TFTR) if a 150 KV switch tube is not readily available and inexpensive. (auth)

12226 (UCRL-Trans—10923) **Electric explosion of foils in arc-quenching media.** Burtsev, V.A.; Gudenko, V.V.; Dubovoi, L.V.; Litunovskii, V.N.; Prokopenko, V.F.; Shchekin, Yu.G. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). Aug 1975. Translation of Russian Preprint T-0224. 18p. Dep. NTIS $4.50.

The results of an experimental study of electrical explosions of foils in solid, liquid, and pulverized media are reported and compared with data obtained by studying foil explosions in air. Electrical explosions of conductors have recently attracted increasing attention in connection with the rapid development of high-current switching gear for high-power supply systems of various electrophysical installations. It is well-known that, in contrast to capacitive energy storage, inductive storage requires the development of circuit-breaking rather than circuit-making gear. The former is technologically much more difficult because of insulation problems during the circuit-breaking process which are accompanied by the appearance of an electric arc. (auth)

12227 **Impact of pulsed energy storage requirements on the overall energy balance in fusion reactors.** Steiner, D. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; **22**: 7(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12228 **Energy storage and switching for tokamak fusion reactors.** Peterson, H.A.; Boom, R.W.; Lue, J.W.; Mohan, N.; Moses, R.W. (Univ. of Wisconsin, Madison). *Trans. Am. Nucl. Soc.*; **22**: 7-9(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12229 **Role of fast-discharging homopolar machines in fusion devices.** Swannack, C. (Los Alamos Scientific Lab., NM); Thomassen, K.; Weldon, D.; Rylander, G.; Tolk, K.; Weldon, W.; Woodson, H. *Trans. Am. Nucl. Soc.*; **22**: 9-10(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

COOLING SYSTEMS

12230 **Containment pressurization from helium pipe rupture in a tokamak.** Chan, C.K. (Univ. of California, Los Angeles). *Trans. Am. Nucl. Soc.*; **22**: 51(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12231 **Analysis of loss-of-flow accidents in lithium-cooled CTR devices.** Botts, T.E.; Ferrell, W.L.; Ullman, A.Z. (Univ. of California, Los Angeles). *Trans. Am. Nucl. Soc.*; **22**: 51-52(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12232 **Safety aspects of liquid lithium in CTR devices.** Ullman, A.Z.; Botts, T.E. (Univ. of California, Los Angeles). *Trans. Am. Nucl. Soc.*; **22**: 52-53(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

FUEL SYSTEMS

REFER ALSO TO CITATION(S) 11714

12233 (COO—2234-9) **Pellets for fusion reactor refueling. Annual progress report, 1 January 1975—31 December 1975.** Turnbull, R.J. (Illinois Univ., Urbana (USA)). Jan 1976. Contract E(11-1)-2234. 91p. Dep. NTIS $5.00.

The feasibility of refueling fusion reactors using pellets of deuterium-tritium is discussed. A pellet injector has been constructed and experiments have been done injecting solid pellets into the ORMAK machine. Theoretical explanations of the results from these experiments have been successful. Other experiments underway include techniques for charging the pellets in order to accelerate and control them.

12234 (LBL—3399(Suppl.), pp II.9.1-II.9.4) **Extraction of energy from high intensity ion beams.** Forrester, A.T. (Univ. of California, Los Angeles). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

In order to restrain electron flow to the collector when ions are decelerated, it is proposed here that a magnetic field B perpendicular to the direction of ion flow and parallel to the collector surface be used. Under these conditions there is a flow of electrons executing cycloid-like paths in a direction perpendicular to both B and the ion beam. The potential variation in the double sheath which exists between the ion beam plasma and the collector surface has been found analytically, and equations from which the required values of B, electron cross-current, and sheath thickness can be ascertained, have been developed. The parameters appear to be of convenient size for all useful ion beams. (auth)

12235 (LBL—3399(Suppl.), pp III.1.1-III.1.7) **Principles of the reflex triode high current pulsed ion accelerator.** Humphries, S. Jr. (Cornell Univ., Ithica, NY). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

The reflex triode pulsed ion accelerator, developed at Cornell, has successfully produced equivalent proton output currents in excess of 6 kiloamperes at 20 amps/cm² for pulse lengths of about 50 nanoseconds. Energies up to 300 keV have been investigated with maximum energy conversion efficiencies of 42 per cent. The principles of operation with mesh anodes are discussed with a review of current experimental results. A theory of triode operation at high energies using plastic foil anodes is presented. The model indicates that it may be possible to achieve efficiencies near unity and ion current densities in excess of the Langmuir-Child limit. An accelerator under construction in which it is hoped to obtain over 50 kiloamperes at 3 MeV is discussed. (auth)

12236 (LBL—3399(Suppl.), pp VI.9.1-VI.9.3) **Duopigatron ion source and neutral injection heating in ORMAK.** Jernigan, T.C.; Davis, R.C.; Morgan, O.B.; Schechter, D.E.; Stewart, L.D.; Stirling, W.L.; Wright, R.E. (Oak Ridge National Lab., TN). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of ion beams.

Two duoPIGatron ion sources with closely coupled gas cells have been applied to ORMAK for neutral beam heating experiments at 200 kW of injected power. Two additional sources are now being added. To meet these power requirements plus the varied requirements necessary for experimental verification of neutral beam heating in tokamaks, modifications and operation in regimes not previously encountered on the test stand have been necessary. Use of focusing multi-aperture electrodes has increased the neutral power deliverable into the ORMAK plasma by 50 percent to the present 100 kW level per injector. At the 25 kV extraction voltage now used, power densities of greater than 5 kW/cm² have been obtained. The addition of focusing electrodes also allows the possibility of matching irregularly shaped entrance apertures in plasma devices. (auth)

12237 (LBL—3399(Suppl.), pp VII.3.1-VII.3.5) **Applications of neutral beam sources science and technology.** Bauer, W.; Eer-Nisse, E.P.; Mattern, P.L.; Musket, R.G.; Schmieder, R.W.; Thomas, G.J. (Sandia Labs., Livermore, CA). 1974.

From Symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

In Proceedings of the second symposium on ion sources and formation of iron beams.

Potential applications of neutral beam sources in science and technology, excluding the primary use of heating CTR plasmas, have been studied and evaluated. The most practical and immediately useful applications are in CTR-related materials research and testing. Novel and potentially useful advantages may be obtained in the use of neutral beam sources for production of neutrons and X rays, and for pumping lasers and masers. Utilization of these sources for machining glasses and ceramics and implanting atoms in metals and semi-conductors also appears promising. (auth)

12238 (UCRL—77216) **Pellet trajectory correction.** Bogdanoff, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Nov 1975. Contract W-7405-Eng-48. 7p. (CONF-751125—138). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The injection of frozen ammonia droplets in the Baseball II magnetic confinement system is discussed. Two ways to correct for random particle trajectories are described: (1) design non-turbulent orifices, and (2) design a trajectory correction system. (MOW)

12239 (UCRL—77406) **Laser microdrilling in the fabrication of laser fusion targets.** Weinstein, B.W.; Hendricks, C.D.; Weir, J.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1975. Contract W-7405-Eng-48. 9p. (CONF-751130—31). Dep. NTIS $3.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

A brief discussion on the use and performance of laser microdrilling is given. The fabrication of a "ball-in-plate" fusion target is described. (MOW)

12240 (UCRL—77645) **Fuel cycle problems in fusion reactors.** Hickman, R.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Jan 1976. Contract W-7405-Eng-48. 25p. (CONF-760203—3). Dep. NTIS $3.50.

From AIME annual meeting; Las Vegas, Nevada, United States of America 'USA' (22 Feb 1976).

Fuel cycle problems of fusion reactors evolve around the breeding, recovery, containment, and recycling of tritium. These processes are described, and their implications and alternatives are discussed. Technically, fuel cycle problems are solvable; economically, their feasibility is not yet known. (auth)

RADIATION HAZARDS

REFER ALSO TO CITATION(S) 11653

12241 **Temperature-dependent ordinary and thermal diffusion of tritium through metal barriers.** Pendergrass, J.H.; Finch, F.T. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.*; **22**: 24-25(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12242 **Assessment of the tritium handling facility for a tokamak experimental power reactor.** Maroni, V.A. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; **22**: 26-27(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12243 **Transmutation of fission products in fusion reactor blankets.** Parish, T.A.; Davidson, J.W.; Draper, E.L. Jr. (Univ. of Texas, Austin). *Trans. Am. Nucl. Soc.*; **22**: 47-48(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12244 **Radioactive waste output from laser-fusion generating stations during normal operations.** Finch, F.T.; Frank, T.G.; Booth, L.A.; Kern, E.A. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.*; **22**: 48(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12245 **Radioactivity and afterheat of a molybdenum alloy structure in the UWMAK-I tokamak fusion reactor design.** Vogelsang, W.F.; Sung, T.Y. (Univ. of Wisconsin, Madison). *Trans. Am. Nucl. Soc.*; **22**: 48-49(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12246 **Safety analysis of some tokamak-type fusion power reactor concepts.** Kastenberg, W.E.; Okrent, D.; Botts, T.; Ferrell, W.L.; Puls, L. Jr. (Univ. of California, Los Angeles). *Trans. Am. Nucl. Soc.*; **22**: 49-50(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

POWER CONVERSION SYSTEMS

12247 (BNL—20727) **Survey of driven tokamaks in EPR and commercial reactor applications.** Usher, J.L.; Powell, J.R. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 16p. (CONF-751125—139). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Evaluation of plasma parameters of driven and ignited Tokamaks for use in experimental power reactor (EPR) and commercial reactor applications has been performed. The purpose of this study is to evaluate the most pessimistic conditions under which a power producing reactor could be operated assuming the use of a high efficiency power (HEP) cycle. The adoption of the HEP cycle will enable a power producing reactor to operate with a plasma Q of 1.5 or less as opposed to a required Q of approximately 8.0 utilizing a conventional conversion cycle. Q is defined as the ratio of thermal fusion power produced to beam input power required. Pessimistic assumptions of large impurity concentrations and short confinement times are made in order to determine the regimes of operation the HEP cycle would render accessible. Characteristic values of plasma and reactor parameters are listed for each of three reactor models for both EPR's and commercial reactors and the favorable implications of the HEP cycle are delineated. (auth)

12248 (UCID—17032) **Water-cooled grid "wires" for direct converters.** Schwer, C.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jan 1976. Contract W-7405-eng-48. 30p. Dep. NTIS $4.00.

A study was conducted to determine the feasibility of internal convective cooling of grid "wires" for direct converters. Detailed computer calculations reveal that the use of small diameter water cooled tubes as grid "wires" is feasible for a considerable range of lengths and thermal fluxes. (auth)

12249 **Sodium-to-water steam generator for fusion power application.** Schluderberg, D.C. (Babcock and Wilcox Co., Lynchburg, VA). *Trans. Am. Nucl. Soc.*; **22**: 22-23(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12250 **Power conversion for UWMAK-III fusion reactor.** Kuo, S.C. (United Technologies Research Center, East Hartford, CT). *Trans. Am. Nucl. Soc.*; **22**: 24(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

INERTIAL CONFINEMENT SYSTEMS

REFER ALSO TO CITATION(S) 11260, 11261, 11263

12251 (AD/A—006250) **Laser-fusion studies at NRL. A report to AEC for the period, July 1973 to June 1974.** Stamper, J.A.; Levine, L.S. (Naval Research Lab., Washington, D.C. (USA)). Oct 1974. 191p. (NRL—7838). NTIS $7.00.

Work done at NRL on laser-fusion-related problems during FY 1974 is summarized. Included are sections related to laser development and to experimental and theoretical studies of laser—plasma interactions. (GRA)

12252 (SAND—75-0562) **Explosive generator development for the SHIVA program. Progress report, January 1, 1975—June 30, 1975.** Butler, R.; Duggin, B.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 27p. Dep. NTIS $4.50.

A series of experiments performed by SLA, Division 5233, has culminated in two parallel plate explosive generator tests for the SHIVA program. The experimental generators were one-sided devices, 150 mm wide and 600 mm long with a spacing of 50 mm between the explosively driven and the stationary plates. Significant new features in these generators included (1) high point density initiation over the entire 150 mm x 600 mm surface of the driver charge with an electrically exploded copper mesh, and (2) use of a distended copper plate for the wiped surface at the load end of the generator. The distended copper plate minimized formation of a metallic jet at the interface between the driven and wiped plates. Both explosive generator tests reached current gains of about 8 and energy gains of about 4 despite early termination of generation associated with the arrival of a conductive shock front in the helium atmosphere.

12253 (UCID—17030) **Estimate of energy density on CYCLOPS spatial filter pinhole structure.** Guch, S. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Sep 1974. Contract W-7405-Eng-48. 7p. Dep. NTIS $3.50.

The inclusion of a spatial filter between the B and C stages in CYCLOPS to reduce the effects of small-scale beam self-focusing is discussed. An estimate is made of the energy density to which the pinhole will be subjected, and the survivability of various pinhole materials and designs is discussed. (MOW)

12254 (UCID—17031) **High power spatial filter considerations, with special emphasis on the cyclops geometry.** Simmons, W.W.; Guch, S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Sep 1974. Contract W-7405-Eng-48. 30p. Dep. NTIS $4.00.

This document presents considerations leading to location and first-cut design of a lens-pinhole-lens spatial filter for Cyclops

laser chain. Small scale beam break-up is the driving phenomenon for spatial filtering, and design is predicated upon estimates of this effect's magnitude. The departure of the beam from diffraction limited performance (due to astigmatism and to whole beam self-focusing) is presented in terms of pinhole size limitations. All calculations are presented in terms of parameters associated with Cyclops, through the B stages, assuming that the spatial filter is located at this point in the chain, and that the focal length of the input spatial filter lens is 100 cm. The geometrical ray diagram is shown.

12255 (UCRL—50035-75(Vol.1)) **Theoretical Physics Division annual report, January—December 1975. Volume 1.** Wainwright, T.; Tarter, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Jan 1976. Contract W-7405-Eng-48. 113p. Dep. NTIS $5.45.

Discussions of theoretical work during this period are reported for the following general areas: (1) atomic, molecular, and nuclear physics, (2) laser fusion, propagation, and effects, (3) pulsed power and plasma physics, (4) energy and the environment, and (5) related research. (MOW)

12256 (UCRL—75885) **Laser driven isothermal implosions.** Dahlbacka, G.; Nuckolls, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Oct 1976. 18p. (CONF-741079—20). Dep. NTIS $3.50.

From 16. annual meeting of the plasma physics division of the American Physical Society; Albuquerque, New Mexico, USA (28 Oct 1974).

A review of laser-compression experiments is given. Diagrams illustrating various compression data are described. (MOW)

12257 (UCRL—76714) **Lawrence Livermore Laser Fusion Program: a status report.** Krupke, W.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Apr 1975. Contract W-7405-Eng-48. 37p. (CONF-750460—6). Dep. NTIS $4.00.

From 3. conference on the laser; New York, New York, USA (22 Apr 1975).

The Laser Fusion Program at the Lawrence Livermore Laboratory is presently emerging from a three-year period of intensive development of the tools required for significant DT implosion experiments of continuously increasing scale. These diverse tools include target design codes, sophisticated target fabrication techniques, radically new diagnostics instrumentation, high peak-power-high brightness laser technology, and fully integrated laser-target-diagnostic irradiation facilities. These tools have recently led to the successful production of neutrons from compressed DT-containing targets together with a wealth of correlating plasma physics data. The current status of major program activities at LLL will be reviewed and major future milestones will be projected. (auth)

12258 (UCRL—77043) **Interaction of 1.06μm laser light with spherical targets imbedded in low density foam.** Thiessen, A.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Oct 1975. Contract W-7405-Eng-48. 16p. (CONF-751130—19). Dep. NTIS $3.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Computer calculations of the interaction of a 1.06 μm laser pulse with a spherical DT-filled glass shell embedded in low density foam are compared with experimental results. Poor coupling of the absorbed energy to the spherical capsule was observed, resulting in a barely detectable neutron signal. The x-ray micrograph shows that the electron conduction in the target was strongly inhibited. Calculational results are presented that indicate the inhibited electron conduction may be the result of large spontaneously-generated magnetic fields. Calculations including the magnetic field are seen to agree reasonably well with the experiment. (auth)

12260 (UCRL—77050) **Comparison of recent experimental results on x-ray emission to lasnex calculations.** Bailey, D.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Nov 1975. Contract W-7405-Eng-48. 14p. (CONF-751130—20). Dep. NTIS $3.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Recently NRL reported the results of x-ray measurements from short pulse Nd laser shots on thick polyethylene slab targets with intensities approaching 10^{16} W/cm^2. Results of similar experiments are reported here. NRL data are shown together with data from the LLL series. Calculations of these experiments were made with the LLL LASNEX MHD code. A comparison is given. (MOW)

12260 (UCRL—77149(Rev.1)) **Energy flux limitation by ionic turbulence.** Manheimer, W.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Feb 1976. Contract W-7405-Eng-48. 21p. (CONF-751130—25). Dep. NTIS $3.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

A quasi-linear theory of energy flux limitation by ion acoustic turbulence is presented. This distribution function is modelled by a Maxwellian plus an additional piece which carries a heat flux Q. By taking the fourth moment of the Vlasov equation one finds the anomalous thermal conductivity K approximately 3 v/sub e/ lambda/sub De/ (e phi/T/sub e/)$^{-2}$. Other moments treated self-consistently include anomalous ion heating, electron cooling, current generation and enhanced inverse bremsstrahlung due to the nonthermal ion fluctuations. (auth)

12261 (UCRL—77231) **Laser fusion target chamber design.** O'Neal, W.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Nov 1975. 5p. (CONF-751125—140). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The SHIVA laser system, which is being built at LLL, consists of a 1.06 μm master oscillator whose 100 picosecond output pulse is beam split into 20 laser amplifier chains, each outputting 1 terawatt for a total of 20 TW with optical aberration of $^1/_2$ wave. Before firing, the beams are automatically aimed at the target within 5 microradians and focused within 7 μm. Computer calculations predict significant thermonuclear burn will be achieved with this system. (MOW)

12262 (UCRL—77731) **Recent developments in laser plasma theory and simulations.** Kruer, W.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. Contract W-7405-eng-48. 19p. Dep. NTIS $3.50.

The principal recent developments are that (1) nonlinear steepening of the density profile strongly modifies absorption processes near the critical density, (2) a sizeable stimulated reflection of light can occur; and (3) energy transport by hot electrons is impeded either by the need to draw a return current, by ion fluctuations generated by this return current, or by self-generated magnetic fields. A brief overview of these results is presented.

12263 **More evidence that fusion works.** Ahlstrom, H.G.; Holzrichter, J.F. (Lawrence Livermore Lab., CA). *Laser Focus;* 1-4(Sep 1975).

Some results from laser-driven implosion experiments are described. Some neutron yield measurements are given along with computer simulation diagrams of imploding targets. (MOW)

12264 **Near-field measurements of subnanosecond-created laser plasmas.** Olsen, J.N.; Mendel, C.W. Jr. (Sandia Labs., Albuquerque, NM). *J. Appl. Phys.;* **46**: No. 10, 4407-4415(Oct 1975).

The near field of expansion for plasmas created by a 40-psec 1.0 to 1.5-J laser has been probed to measure the electron density and local electric and magnetic fields. Holographic interferometry was used to measure the electron density in the range 10^{17} to 6 x 10^{18} cm^{-3} at delays of 2.5 to 22 nsec. Space-charge electric fields of up to 1900 V/cm were detected by deflection of a fast He^+ ion beam probe as late as 26 nsec after irradiation. Spontaneous magnetic fields of up to 50 G, rising in 10 nsec, were seen 4 mm from the target, decaying rapidly and often reversing at 8 mm. The temperature in the blowoff estimated from the combination of local electric field and electron-density scale length is high compared to predictions based on a peak T/sub e/ = 160 eV inferred from a multichannel soft x-ray spectral analysis. An anisotropic fast ion group appears in the interferometric density profiles and ejection of approximately 10^9 fast electrons is observed in the electric field measurements. These effects are compared to the early time ion collector signal and nonthermal x-ray spectrum, respectively. (auth)

12265 **Energy deposition in a two-dimensional LFR model.** Bosler, G.E. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **22**: 15-16(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12266 **High-power isolator for the 10-μm region employing interband Faraday rotation in germanium.** Phipps, C.R. Jr.; Thomas, S.J. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). *J. Appl. Phys.;* **47**: No. 1, 204-213(Jan 1976).

Interband Faraday rotation in intrinsic germanium has been employed to construct a room-temperature optical isolator for use in the intermediate infrared region. The device was tested at 9.55- and 10.59-μm wavelengths, and exhibited an isolation level of 41

dB at 10^4 W cm^{-2}. The rotation is shown to be relatively insensitive to temperature at the two wavelengths and linear in magnetic field intensity up to 83 kG. The isolator figure of merit is about 60 deg per dB attenuation. (AIP)

COMPONENT DEVELOPMENT AND TESTING

REFER ALSO TO CITATION(S) 11009, 11036, 11046, 11087, 11117, 11681, 11759

12267 (BNWL—1961) **Some experimental considerations regarding ion beam simulation of neutron irradiation for mechanical property measurements.** Styris, D.L.; Jones, R.H.; Harling, O.K.; Kulcinski, G.L.; Marshall, R.P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 122p. Dep. NTIS $5.50.

A preliminary assessment of the requirements for mechanical property data related to CTR materials is given. The status of ion simulation for mechanical property measurements is described. A damage analysis and calculations for light ions are presented along with sample size, heating and cooling, and surface considerations. (MOW)

12268 (CONF-751125—127) **Low noise control valve.** Christie, R.S. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1975. 16p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Noise is one of the problems associated with the use of any type of control valve in systems involving the flow of fluids. The advent of OSHA standards has prompted control valve manufacturers to design valves with special trim to lower the sound pressure level to meet these standards. However, these levels are in some cases too high, particularly when a valve must be located in or near an area where people are working at tasks requiring a high degree of concentration. Such locations are found around and near research devices and in laboratory-office areas. This paper describes a type of fluid control device presently being used at PPL as a bypass control valve in deionized water systems and designed to reduce sound pressure levels considerably below OSHA standards. Details of the design and construction of this constant pressure drop variable flow control valve are contained in the text and are shown in photographs and drawings. Test data taken are included. (auth)

12269 (CONF-760209—1) **Changes in surface conditions with first plasma in the Princeton Large Torus (PLT).** Dylla, H.F.; Cohen, S.A. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1976. 14p. Dep. NTIS $3.50.

From 2. international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America [USA] (16 Feb 1976).

In—situ measurements are reported of the changes in surface composition of 305 stainless steel exposed to the first plasma discharges in PLT. Auger electron spectroscopy of pre-exposure surfaces shows a multilayer coverage of carbon and a fractional monolayer coverage of oxygen. Surfaces subjected to increasing levels of plasma exposure show substantial removal of the carbon multilayer, increased fractional-monolayer coverages of oxygen and iron, and tenth-monolayer quantities of chlorine and sulfur. (auth)

12270 (CONF-760209—2) **Impurity and surface studies in ORMAK.** Colchin, R.J.; Bush, C.E.; Jahns, G.L.; Lyon, J.F.; Murakami, M.; Neidigh, R.V.; Shaeffer, D.L. (Oak Ridge National Lab., Tenn. (USA)). 1976. 22p. Dep. NTIS $3.50.

From 2. international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America [USA] (16 Feb 1976).

The ORMAK tokamak has been in operation since 1971, and surface impurity problems have been pursued from the beginning. Surface studies of materials removed from ORMAK have revealed the presence of C, O, and Fe. These are also the principal impurities observed spectroscopically in plasma discharges, although numerous other elements are present in lesser amounts. Spectroscopy, x-ray measurements, plasma resistance, and fast ion scattering have been used in an effort to determine Z/sub eff/, the effective nuclear charge of plasma ions. All four measurements have practical difficulties leading to relatively large experimental error limits. Oxygen discharge pre-cleaning has allowed ORMAK discharges to reach higher currents and correspondingly higher ion and electron temperatures; spectroscopic studies reveal a lower level of contaminants, particularly C and N. Power measurements indicate that most of the input power strikes the walls, mostly as radiation. By varying operating parameters it is found that Z/sub eff/ approximately 1/sub p//anti n/sub e/. (auth)

12271 (CONF-760209—4) **Plasma-wall interaction in ATC during high power neutral beam injection.** Cohen, S.A. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). 1976. 21p. Dep. NTIS $3.50.

From 2. international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America [USA] (16 Feb 1976).

Measurements of the elemental composition of the vacuum vessel wall surface and impurity influx into ATC during high power beam-heated discharges are combined with previous measurements of power balance and scaling laws to give a self consistent model of plasma-wall interaction in ATC. It is shown that plasma charge exchange induced desorption is the main cause of impurity influx during neutral beam injection. Impurities change the net power balance in these beam-heated discharges by approximately 15 percent. (auth)

12272 (CONF-760415—1) **Coatings application for fusion research.** Simpkins, J.E. (Oak Ridge National Lab., Tenn. (USA)). 1976. 17p. Dep. NTIS $3.50.

From International conference on metallurgical coatings; San Francisco, California, United States of America [USA] (5 Apr 1976).

A large stainless steel toroidal inner vacuum liner, with a major radius of 79.5 cm and minor radius of 23.5 cm, has been coated with gold to minimize gas adsorption and to provide an inert surface for the plasma in ORMAK, a fusion experiment. A thin platinum film, deposited prior to the gold coating, acts as a diffusion barrier and prevents many of the constituents of the steel substrate from diffusing through the gold to the surface. In a fusion reactor the walls exposed to the plasma will be bombarded by highly energetic neutrals and a gold surface may not be suitable because of its relatively high sputtering yield. Several other materials, some of which may be more suitable for use as a "first wall" surface than gold have been identified but many of these candidates are expected to be impractical to use in their bulk form. A solution is a composite wall consisting of a suitable coating on a substrate chosen for its strength and ease of fabrication. The techniques employed to deposit several of these candidate materials onto stainless steel substrates as thick coatings are described.

12273 (ERDA—1548(Draft)) **Intense Neutron Source facility, Los Alamos Scientific Laboratory, Los Alamos, New Mexico. Draft environmental statement.** (Energy Research and Development Administration, Washington, D.C. (USA)). Jan 1976. 232p. USERDA, Washington, DC.

Two neutron sources are planned for the INS facility, each designed to produce 10^{15} 14-MeV neutrons per second continuously and for long periods of time. These intense sources of fusion neutrons are achieved by intersecting an accelerated tritium ion beam and a supersonic jet of deuterium gas. The handling of the tritium and deuterium will provide experience of considerable value to the fusion power program. The purpose of the proposed project is to provide an experimental facility for national and international use in materials research and development using fusion-energy neutrons. The facility will provide a neutronic environment accessible for experimental irradiations similar to the radiation environment anticipated in a fully operational fusion-power reactor. In particular, the effects of high-level neutron irradiation on metals and insulators used in controlled thermonuclear research may be studied.(TFD)

12274 (MATT—1183) **Vacuum and wall problems in precursor reactor tokamaks.** Cohen, S.A. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. (CONF-751023—6). Dep. NTIS $5.45.

From 22. national vacuum symposium; Philadelphia, Pennsylvania, USA (28 Oct 1975).

The Princeton Large Torus (PLT) will be completed in 1975 and two other CTR oriented toroidal plasma devices, the Poloidal Divertor Experiment (PDX) and the Tokamak Fusion Test Reactor (TFTR). are planned to be completed in 1977 and 1981. The vacuum systems of these machines must satisfy stringent requirements because of unusual operating conditions, such as, magnetic field induced strains and eddy currents, energetic particle and photon bombardment, large transient gas loads, and the use of 100 Curie quantities of tritium. In addition, novel vacuum wall surfaces and fast moving mechanical or magnetic plasma limiters will be required to minimize the influx of impurities during discharges. (auth)

12275 (MATT—1186) **Comparison of the D-T neutron wall load distributions in several tokamak fusion reactor designs.** Chapin, D.L.; Price, W.G. Jr. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 49p. Dep. NTIS $4.00.

The distributions of the neutron angular and scalar flux and current around the wall of three proposed tokamak fusion reactor designs are investigated in detail. The calculational method involves a numerical solution of the integral form of the neutron transport equation using a ray tracing process. The wall loading in a circular cross section tokamak and in two non-circular tokamaks, the Princeton Reference Design and the University of Wisconsin UWMAK, are compared for three different plasma source distributions. The variation of the angular neutron flux at different wall points is investigated for each design. Neutron wall load peaking factors are also calculated and compared for each design, and are found to be sensitive to both the wall shape and plasma source. The divertors in the two non-circular designs are studied for neutron streaming losses and for the wall load in those regions. (auth)

12276 (UCID—16989) **Plasma focus project.** Sahlin, H.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1975. Contract W-7405-Eng-48. 22p. Dep. NTIS $3.50.

The primary objective of this project is to provide a relatively simple pulsed power source for high density pulsed fusion studies with a variety of DT and other fusion microexplosion targets. The plasma focus operated on DT at 1 MJ should produce greater than or equal to 10^{15} DT neutrons per pulse corresponding to 2800 J of nuclear energy release and for low pressure operation and appropriately configured high Z anode center should yield an x-ray burst of about 1000 J with a substantial fraction of this x-ray energy concentrated in the 5-100 kV range. Because of its x-ray and neutron production potential, the operation of the focus as an x-ray source is also under study and an initial design study for a repetitively pulsed 1 MJ plasma focus as a pulsed neutron materials testing source has been completed. The plasma focus seems particularly appropriate for application as a materials testing source for pulsed fusion reactors, for example, based on laser driven fusion microexplosions. The construction status of the device is described. (MOW)

12277 (UCID—17055) **DT fusion neutron irradiation of BNL-LASL superconductor wires, BPNL nickel and molybdenum, ORNL magnesium oxide, UW-LLL metallic foils, and LLL aluminum tensile.** MacLean, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Nov 1975. Contract W-7405-Eng-48. 12p. Dep. NTIS $3.50.

The experimental procedure for testing the samples is given. No test results are indicated. (MOW)

12278 (UCID—17075) **DT fusion neutron irradiation of LLL copper tensile specimens at 210°C and SLL fiber optic bundles.** MacLean, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Dec 1975. Contract W-7405-Eng-48. 10p. Dep. NTIS $3.50.

The experimental procedure for testing the samples is given. No test results are indicated. (MOW)

12279 (UCRL—77072) **Neutron time-of-flight spectrometer for laser-fusion experiments.** Lerche, R.A.; Coleman, L.W.; Houghton, J.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1975. Contract W-7405-Eng-48. 19p. (CONF-751130—24). Dep. NTIS $3.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

The basic concept of a time-of-flight spectrometer is illustrated. The spectrometer described can measure 14.1-MeV neutrons coming directly from the D-T plasma and also neutrons scattered by the air or ground or other structures within the vicinity of the flight path. (MOW)

12280 (UCRL—77796) **Control of first-wall surface conditions in the 2XIIB magnetic mirror plasma confinement experiment.** Simonen, T.C.; Bulmer, R.H.; Coensgen, F.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Feb 1976. 20p. (CONF-760209—3). Dep. NTIS $3.50.

From 2. international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America [USA] (16 Feb 1976).

The control of first-wall surface conditions in the 2XIIB Magnetic Mirror Plasma Confinement experiment is described. Before each plasma shot, the first wall is covered with a freshly gettered titanium surface. Up to 5 MW of neutral beam power has been injected into 2XIIB, resulting in first-wall bombardment fluxes of 10^{17} atoms.cm^{-2}.s^{-1} of 13-keV mean energy deuterium atoms for several ms. The background gas flux is measured with a calibrated, 11-channel, fast-atom detector. Background gas levels are found to depend on surface conditions, injected beam current, and beam pulse duration. For our best operating conditions, an effective reflux coefficient of 0.3 can be inferred from the measurements. Experiments with long-duration and high-current beam injection are limited by charge exchange; however, experiments with shorter beam duration are not limited by first-wall surface conditions. It is concluded that surface effects will be reduced further with smoother walls. (auth)

12281 (UCRL—77799) **Surface bombardment rates for mirror fusion reactor designs.** Moir, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Feb 1976. Contract W-7405-eng-48. 25p. (CONF-760209—17). Dep. NTIS $3.50.

From 2. international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America [USA] (16 Feb 1976).

Arrival rates of D^0, T^0, D^+, T^+, He^{++}, neutrons, and photons are given for FERF (Fusion Engineering Research Facility, a mirror confinement reactor dedicated to materials research and to component testing), a hybrid fusion-fission reactor designed primarily to produce fissile fuel, and a D-T power reactor design. For comparison a next-generation confinement-mirror experiment called MX is included. The surfaces of interest are the first wall, the end wall, the direct converter and the injector. (auth)

12282 **ERDA surface physics program for controlled thermonuclear fusion.** Finfgeld, C.R. (Energy Research and Development Administration, Washington, DC). *Trans. Am. Nucl. Soc.*; 22: 28(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12283 **Vaporization thermodynamics and sputtering of binary targets such as metal oxides.** Gruen, D.M.; Finn, P.A.; Page, D.L. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; 22: 29(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12284 **Low-yield sputtering measurements on CTR materials using Auger electron spectroscopy.** Smith, J.N. Jr.; Meyer, C.H. Jr.; Layton, J.K. (General Atomic, San Diego, CA). *Trans. Am. Nucl. Soc.*; 22: 29-30(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12285 **Helium and hydrogen implantation effects in graphites.** Bauer, W. (Sandia Labs., Livermore, CA); Thomas, G.J.; Granoff, B. *Trans. Am. Nucl. Soc.*; 22: 30-31(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12286 **Photodesorption from metal and metal oxide surfaces.** Shapira, Y.; Lichtman, D. (Univ. of Wisconsin, Milwaukee). *Trans. Am. Nucl. Soc.*; 22: 31(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12287 **Sputtering of ions from stainless steel by hydrogen bombardment.** Cohen, S.A. (Princeton Plasma Physics Lab., NJ). *Trans. Am. Nucl. Soc.*; 22: 31-32(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12288 **Graphite surface erosion and deformation.** Feinberg, B.; Post, R.S. (Univ. of Wisconsin, Madison). *Trans. Am. Nucl. Soc.*; 22: 32-33(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12289 **Numerical simulation of light ion sputtering of amorphic layered solids.** Cohen, S.A.; Jensen, R.V.; Matsuda, Y.; Okuda, H. (Princeton Plasma Physics Lab., NJ). *Trans. Am. Nucl. Soc.*; 22: 33-34(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12290 **Plasma-wall interface studies for tokamak-type plasmas.** Barnett, C.F.; Ricci, E. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.*; 22: 35(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12291 (D,T) neutron sputtering and radioactive recoil ejection from the surface of fusion reactors. Harling, O.K.; Thomas, M.T.; Brodzinski, R.L.; Rancitelli, L.A. (Battelle Northwest Labs., Richland, WA). *Trans. Am. Nucl. Soc.*; 22: 35-36(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12292 Depth distribution of implanted helium and surface blistering in erbium and erbium deuteride. Blewer, R.S. (Sandia Labs., Livermore, CA). *Trans. Am. Nucl. Soc.*; 22: 36(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12293 Low-energy hydrogen implantation of titanium and stainless steel. Wilson, K.L.; Thomas, G.J.; Bauer, W. (Sandia Labs., Livermore, CA). *Trans. Am. Nucl. Soc.*; 22: 36-37(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12294 Atomistics of diffusion in metals during helium implantation. Baskes, M.I.; Wilson, W.D. (Sandia Labs., Livermore, CA). *Trans. Am. Nucl. Soc.*; 22: 37-38(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12295 Pulsed sphere measurements and calculations for materials used in fusion reactor design. Hansen, L.F.; Wong, C.; Komoto, T.; Anderson, J.D. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.*; 22: 40(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12296 Materials resource requirements for D—T fusion power reactors. Kulcinski, G.L. (Univ. of Wisconsin, Madison). *Trans. Am. Nucl. Soc.*; 22: 54-55(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12297 Proposed federal helium conservation policy as related to the helium demands of energy-related new technologies. Hammel, E.F. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.*; 22: 56(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12298 Availability of beryllium. Cameron, E.N. (Univ. of Wisconsin, Madison). *Trans. Am. Nucl. Soc.*; 22: 56-57(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

12299 Potential availability of U.S. and world beryllium mineral resources in the period 2000—2020 AD. Bass, N.W. (Brush Wellman, Inc., Cleveland). *Trans. Am. Nucl. Soc.*; 22: 57-58(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

GENERAL AND MISCELLANEOUS

MANAGEMENT

REFER ALSO TO CITATION(S) 10788

12300 (ANL—76-1) Argonne National Laboratory patent portfolio. Huguelet, B.C. (comp.). (Argonne National Lab., Ill. (USA)). Jan 1976. Contract W-31-109-Eng-38. 53p. Dep. NTIS $5.50.

This booklet contains the abstracts of all active U. S. patents on technology items that originated at ANL, the applicability of which is not limited to nuclear reactors. Also listed are the titles of all ANL-originated nuclear-related U. S. patents that are still in force. Selected technology items for which patent applications have been filed and are available for licensing are included in several categories. Categories included in this booklet are as follows: atmospheric and earth sciences; biological and medical sciences; chemistry and chemical engineering; cryogenics and superconductivity; electronics and electrical engineering; energy conversion; measurements and controls; methods and devices; materials and fabrication; physics, accelerators and fusion; and selected nuclear-related technology. (RWR)

12301 (ERDA—100) Report of the Field and Laboratory Utilization Study Group. (Energy Research and Development Administration, Washington, D.C. (USA)). Dec 1975. 59p. Dep. NTIS 4.50.

The Field Laboratory Utilization Study Group of ERDA concentrated on organizational and management improvements that might contribute to the optimum utilization of existing field and laboratory resources in accomplishing the mission of ERDA. Emphasis was on provisions affecting the management decision-making process. After an executive summary and introduction, the group's findings are presented in chapters entitled organization and management practices, planning and control, technology transfer/commercialization, and performance/quality. Recommendations are presented in two parts, on organization and management and planning/control. 8 figures (RWR)

12302 (ERDA—100(App.)) Report of the Field and Laboratory Utilization Study Group. Appendix. (Energy Research and Development Administration, Washington, D.C. (USA)). Dec 1975. 170p. Dep. NTIS $6.75.

These appendices (ERDA organization and management, summary of other resources, and FLU study considerations/inputs) provide detailed and quantitative information in support of the findings and recommendations presented in the report of the field and laboratory utilization study group. (RWR)

12303 (SC-M—68-801) Interagency mechanical operations group numerical systems group. Minutes of the 18th meeting, October 8-10, 1968, Burlington, Iowa. Frauenglass, H. (Sandia Labs., Albuquerque, N.Mex. (USA)). Oct 1968. 40p. (CONF-681092—(absts)). Dep. NTIS $5.25.

From Fall meeting of the interagency mechanical operations group numerical systems group; Burlington, Iowa, USA (8 Oct 1968).

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 10346, 10783, 11219, 11372, 11385, 11387, 11443, 11919, 12143

12304 (BNL—20685) Design automation for entire digital systems. Peskin, A.M. (Brookhaven National Lab., Upton, N.Y. (USA)). Nov 1975. 21p. (CONF-760320—1). Dep. NTIS $3.50.

From 9. annual simulation symposium; Tampa, Florida, United States of America "USA" (17 Mar 1976).

MODEL/LINDA is a unified logic design automation system centered around a base hardware description language called MODEL. This language and its simulator bear several important advantages in comparison to most predecessor logic design automation codes. Perhaps the most important of these is that it was designed for extensibility and, hence, was able to incorporate techniques for modeling many aspects of computer software as well as hardware. This made MODEL a very useful tool for analyzing and validating digital systems designs in their entirety. 2 figures, 2 tables. (auth)

12305 (KFK—2175) IPOL: a FORTRAN routine for two dimensional interpolation. Guenther, C. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Nov 1975. 32p. Dep. NTIS (US Sales Only) $4.00.

Let a set of N real points, (x/sub i/, y/sub i/), i = 1, 2, ..., N, be given. The FORTRAN subroutine IPOL calculates a maximum number v greater than or equal to 1 of linearly independent polynominals, $P_1(x,y)$, ..., P/sub v/(x,y), which are of least possible degree g and which have the (x/sub i/, y/sub i/) as zeros, P/sub K/(x/sub i/, y/sub i/) = O for i = 1, 2, ..., N and K = 1, ..., v. IPOL is used to find polynominals P(x,y) vanishing in a given point set. This is done by setting P(x,y): = $P_1(x,y)$ if v = 1, and if v > 1 by taking a suitable linear combination of $P_1(x,y)$, ..., P/sub v/(x,y). An example is given for a multivariate interpolation problem. In addition, an aspect of numerical integration can be clarified by the use of IPOL. For some quadrature formulas of polynominal degree 2l-1 in two dimensions, the number of linearly independent polynominals of degree l which have the points of these formulas as zeros is given. 2 figures, 1 table. (auth)

12306 (KFK—2229) **Tool for the simulation of the dynamic behavior of operating system software.** Rupp, M.; Nehmer, J. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Datenverarbeitung in der Technik). Nov 1975. 31p. Dep. NTIS (US Sales Only) $4.00.

The characteristics of a simulation system to study the dynamic behavior of operating system software in detail are described. The use of the system, which appears to the application programer like a virtual PL/I machine, is illustrated by an example. 4 figures. (auth)

12307 (KFK-PDV—48) **Adaptive process control with trend model.** Schaffrath, G.; Shahata, M. (Kernforschungszentrum Karlsruhe (F.R. Germany). Projekt Prozeslenkung mit DV-Anlagen). Aug 1975. 136p. (In German). Dep. NTIS (US Sales Only) $6.00.

The intention of this work was the development of a universal model for adaptive control. The proposed trend model is a statistical description of rapidly varying processes which are otherwise difficult to describe. The model uses only signals from a plant in usual action, because test signals are often prohibited by costs and safety regulations. The algorithms are formulated in a general way to be used for the identification of a system as well as for its control. The conditions of real time action and the capabilities of process computers allow only for algorithms with restricted running time and core requirements. The described trend algorithms worked well under the conditions of several real applications. 28 figures (auth)

12308 (KFK-PDV—54) **Control algorithms for digital control with process computers: synthesis, simulation, comparison.** Isermann, R.; Bux, D.; Blessing, P.; Kneppo, P. (Stuttgart Univ. (TH) (F.R. Germany). Fachbereich Energietechnik). Aug 1975. 139p. (In German). Dep. NTIS (US Sales Only) $3.00.

Methods for the design of parameter-optimized, deadbeat and state variable control algorithms are described, which are especially suited for computer-aided design. It is assumed that a process model in parametric and time-discrete form has been obtained by process identification. Results of simulations give hints for the design, especially for the selection of sampling time and the weighting factor of the process input. Eight selected control algorithms are compared with regard to the resulting control performance, sensitivity for inexact process models, computing time between samples, computing time and storage for synthesis with process computers. Finally, methods for the design of feed forward control algorithms are described. 30 figures, 11 tables. (auth)

12309 (LBL—4636) **Generalized conjugate gradient method for nonsymmetric systems of linear equations.** Concus, P.; Golub, G.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1975. Contract W-7405-ENG-48. 12p. (CONF-751230—1; STAN-CS—75-535). Dep. NTIS $3.50.

From 2. international symposium on computing methods in applied sciences and engineering; Versailles, France (15 Dec 1975).

A generalized conjugate gradient method is considered for solving systems of linear equations having nonsymmetric coefficient matrices with positive-definite symmetric part. The method is based on splitting the matrix into its symmetric and skew-symmetric parts, and then accelerating the associated iteration by using conjugate gradients; the method simplifies in this case, as only one of the two usual parameters is required. The method is most effective for cases in which the symmetric part of the matrix corresponds to an easily solvable system of equations. Convergence properties are discussed, as well as an application to the numerical solution of elliptic partial differential equations.

12310 (ORNL/TM—3790(Pt.3)) **CATCH: Computer Assisted Topography, Cartography, and Hypsography. Part III. PERSPX: a subroutine package for perspective and isometric drawings.** Tucker, T.C. (Oak Ridge National Lab., Tenn. (USA)). Feb 1973. Contract W-7405-eng-26. 74p. Dep. NTIS $4.50.

Computer subroutines have been designed and programmed to produce line drawings in either perspective or isometric projection of three-dimensional surfaces which are specified by elevation (Z) at all points on a two-dimensional (X-Y) grid. Hidden lines are eliminated in all cases for isometric drawings and for virtually all cases in perspective drawings. The subroutines allow use of the projection as a base drawing for additional information by returning the plot coordinates and visibility of each point in the input grid. These subroutines require approximately 12K bytes of IBM/360 core in addition to that necessary for the data arrays passed to and from the subroutines. Execution time for an array of 101 by 101 points is about 3.5 cpu seconds in a multiprocessing 360/91 and about 10 cpu seconds in a 360/75. For those who wish to use a minimal amount of machine memory, an alternate version is included which increases execution time about 20 percent and does not return information for each point. Although these subroutines are coded for a CALCOMP 835 cathode-ray-tube plotter, other high speed plotting devices might be used. (auth)

12311 (SAND—75-0487) **Procedure to produce error estimates for difference approximations to differential equations. I. Introduction and illustration of the basic concept.** Hicks, D.L. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 28p. Dep. NTIS $5.00.

By embedding discrete difference equations into continuum difference equations and taking the derivative with respect to the mesh size, a differential-difference equation is generated. The solution of this differential-difference equation is used to estimate the distance between the solution of the difference equation and the limit solution as the mesh size goes to zero. This method provides a general procedure for producing an estimate of the error made in approximating a solution to a differential equation with a solution of a difference equation. (auth)

12312 (SAND—75-0578) **Threedy difference method.** Hicks, D.L.; Lauson, H.S.; Madsen, M.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 37p. Dep. NTIS $5.00.

THREEDY is a three-dimensional wave propagation code which employs operator splitting. This report describes the difference method in THREEDY. (auth)

12313 (UCID—30130) **Preliminary documentation of GEARIB: solution of implicit systems of ordinary differential equations with banded Jacobian.** Hindmarsh, A.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1976. Contract W-7405-Eng-48. 10p. Dep. NTIS $4.00.

This report is a preliminary version of documentation for a new package, GEARIB. The package solves systems of ordinary differential equations in the implicit form $Ay = g$, with A and the partial derivative of g with respect to y treated in band matrix form. (auth)

12314 (UCRL—50025-75-3) **Electronics Engineering Department quarterly report No. 3, 1975.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Jul 1975. Contract W-7405-Eng-48. 32p. Dep. NTIS $4.00.

Several projects of the EE department at Lawrence Livermore Laboratory are briefly described. The following items are discussed: a modular microcomputer system, a control system for automated chemical analyses for use in fast rabbit/rapid chemistry, microcomputers for logging of effluent characteristics, an automated message processing system, microcomputers for controlling fast-transient oscilloscopes, a programmable machine-control system, microcomputers for wind calculations, and the use of microcomputers for computation. A microcomputer technology-transfer program with nearby community colleges is also described. 27 figures, 1 table (RWR)

12315 (UCRL—77353) **Monte Carlo approach to numerical deconvolution.** Ekstrom, M.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Jan 1976. Contract W-7405-eng-48. 6p. (CONF-760413—1). Dep. NTIS $3.50.

From IEEE international conference on acoustics, speech and signal processing; Philadelphia, Pennsylvania, United States of America "USA" (12 Apr 1976).

A numerical procedure for solving deconvolution problems is presented. The procedure is based on the Monte Carlo method, which statistically estimates each element in the deconvolved excitation. A discrete Fourier transform technique is used to improve the quality of these estimates for a prescribed amount of computation. (auth)

12316 (UCRL—77863) **Computer memory: the LLL experience.** Fletcher, J.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1976. Contract W-7405-eng-48. 14p. (CONF-760319—1). Dep. NTIS $3.50.

From The advanced memory concepts workshop; Menlo Park, California, United States of America "USA" (23 Mar 1976).

Those aspects of Octopus computer network design are reviewed that relate to memory and storage. Emphasis is placed on the difficulties and problems that arise because of the limitations of present storage devices, and indications are made of the directions in which technological advance could be of most value. (auth)

12317 (UCRL—77868) **High level languages in microcomputer automation.** Fisher, E.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Feb 1976. 6p. (CONF-760502—1). Dep. NTIS $4.50.

From ELECTRO-76; Boston, Massachusetts, United States of America "USA" (11 May 1976).

With the increasing use of microcomputers in scientific instrumentation, it is important to discuss the possibility of providing

an instrument with "built-in" computer control. Programming techniques which allow the scientist or operator to control interactively the configuration of an experiment are described. To program his application the scientist will communicate with his instrument by means of an immediately interactive high-level language. The feasibility of providing this type of capability on microcomputers was studied by examining and comparing the PL-1-like language PLM and BASIC. 4 figures. (RWR)

12318 Three-dimensional display of mathematical figures. Crook, R.C.; Dickman, D.O.; Winkler, M.A. (to U.S. Energy Research and Development Administration). US Patent Application 562,289. Filed date 26 Mar 1975. 5p.

A method for synthesizing a three-dimensional figure from single plane waves generated by a computer is detailed. 3 figures. (auth)

12319 Random number set for Monte Carlo computations. Frigerio, N.A.; Clark, N.A. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.*; 22: 283-284(Nov 1975).

From American Nuclear Society 1975 winter meeting; San Francisco, CA, USA (16 Nov 1975).

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 10827, 10828, 11774

12320 (EUR—5295e) Study of the management information requirements of the Communities' environment program. (Commission of the European Communities, Brussels (Belgium)). 1975. 46p. Dep. NTIS (US Sales Only) $4.00. EUR FB 210,-.

A study has been carried out of the information needs of those responsible for the management of the environment within Member States of the European Communities and other European countries. The study has been undertaken to determine what is required to support the Program of action of the European Communities on the Environment set out in the Declaration of the Council and of the representatives of the Governments of the Member States in the Council of 22nd November 1973. The report describes how the study was conducted and presents the results. It is concluded that an Environmental Management Information Network will need to be developed in order to help the Environment Program. The Network will provide the means of exchanging information so that the goals of the program can be met as quickly and economically as the difficulty and complexity of the problems allow. It will also assist the Member States and the Commission in meeting their responsibilities to the United Nations Environment Program and its data and information needs. A scheme for the Network is presented and it is suggested that this can be applied at a subnational, national and community level. Recommendations are made for the steps to be taken to develop the Network. (auth)

CORPORATE INDEX

In the corporate index, technical report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, where applicable, are given in parentheses at the end of the entry.

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Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.
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Hydrologic data for the Idaho National Engineering Laboratory site, Idaho, 1:11465 (IDO—22055)
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Title (supplementary information), citation number (report number)

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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75/506	1:10803	*See* PB-244984
75/507	1:10804	*See* PB-244985
75/508	1:10805	*See* PB-244986
75/509	1:10808	*See* PB-244989
75/510	1:10807	*See* PB-244988
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75/513	1:10809	*See* PB-244990
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75/585	1:10907	NTIS
75/587	1:10811	*See* PB-245828
75/613R	1:10768	*See* FEA/D-76/056
75/614R	1:10768	*See* FEA/D-76/056
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76/078	1:10769	GPO
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74/569	1:10810	*See* PB-245206
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FEA/EI-1658	1:10914	*See* PB-245194
FEA/G-75/96	1:10898	*See* PB-242474
75/255	1:10864	*See* PB-242493
75/487	1:10856	*See* PB-245216
75/593	1:10850	NTIS
76/158	1:10861	NTIS
FEA-N-75/713	1:10793	GPO, $7.30, Stock No. 041-018-00097-6
FRCMWG/P-(75)163	1:12075	*See* RD/B/N-3178
FREDSWG/P-(75)9	1:12075	*See* RD/B/N-3178
FRNC-CONF-130	1:11062	INIS
FRRSR-10	1:10713	Dep. NTIS, $5.50
FSTC-HT-23-423-74	1:10925	*See* AD-A-008253
23-751-73	1:10255	*See* AD-A-008258
23-807-74	1:10271	*See* AD/A-005963
23-0121-75	1:10918	*See* AD-A-008343
23-0165-75	1:10924	*See* AD/A-005209
23-0999-74	1:10758	*See* AD/A-005060
23-1002-74	1:10756	*See* AD/A-005065
23-1574-71	1:10411	*See* AD/A-005918
23-1635-73	1:10923	*See* AD/A-005205
FTD-HC-23-0750-75	1:10334	*See* AD/A-006694
FTD-MT-24-2004-74	1:10394	*See* AD/A-006007
GA-A-13267	1:10495	Dep. NTIS, $5.45
13348	1:10328	Dep. NTIS, $10.50
13422	1:10496	Dep. NTIS, $4.00
13556	1:10497	Dep. NTIS, $5.45
13617(Vol.3)	1:10684	Dep. NTIS, $7.60
13617(Vol.4)	1:10685	Dep. NTIS, $7.60
13661	1:12186	Dep. NTIS, $4.00
13727	1:10686	Dep. NTIS, $4.00
13737	1:10498	Dep. NTIS, $7.60
13740	1:10646	Dep. NTIS, $7.60
13766	1:10521	Dep. NTIS, $7.60
13778	1:10499	Dep. NTIS, $5.45
13779	1:10687	Dep. NTIS, $4.00
13793	1:10500	Dep. NTIS, $4.00
13814	1:10501	Dep. NTIS, $4.00
13823	1:10502	Dep. NTIS, $5.45
GEAP-10028-56	1:10522	AT
14073-1	1:11913	AT
GJO-109(76-1)	1:10279	Dep. NTIS, $4.00
110(76)	1:10280	Dep. NTIS, $5.50
1649	1:10281	Dep. NTIS, $5.50
HEDL-SA-753	1:10654	Dep. NTIS, $3.50
909	1:10688	Dep. NTIS, $4.00
921	1:10655	Dep. NTIS, $4.00
928-S	1:10608	Dep. NTIS, $3.50
929A	1:10523	Dep. NTIS, $3.50
9045	1:10302	Dep. NTIS, $3.50
HEDL-TC-327	1:10524	AT
HEDL-TI-76004	1:10656	Dep. NTIS, $4.00
HEDL-TME-75-12	1:10525	Dep. NTIS, $13.60
75-53	1:11389	Dep. NTIS, $3.50
75-54	1:10657	AT
75-62	1:10345	AT
75-65	1:10658	AT
75-102	1:10329	Dep. NTIS, $4.00
75-104	1:11082	AT
75-133	1:11289	Dep. NTIS, $4.50
75-134	1:11290	Dep. NTIS, $5.00
ICP-1052	1:10314	Dep. NTIS, $8.50
IDO-22055	1:11465	Dep. NTIS, $5.50
IEA(M)-75-5	1:10868	Dep. NTIS, $8.00
IEC-446-OC-1649	1:10342	*See* PB-241300
IFA-FA-1-1975	1:12102	Dep. NTIS (US Sales Only), $4.00
IFA-FR-138-1975	1:10370	Dep. NTIS (US Sales Only), $3.50
INTEL-RT-8027-012	1:11115	*See* AD/A-008050
IPNO/TH-75-24	1:11948	Dep. NTIS, $4.00
IRS-W-17(11-75)	1:11553	Dep. NTIS (US Sales Only), $5.50
IS-2629	1:10981	Dep. NTIS, $5.00
3558(Vol.1)	1:11140	Dep. NTIS, $13.50
IS-M-62	1:11390	Dep. NTIS, $4.00
IS-T-691	1:11083	Dep. NTIS, $6.00
702	1:11068	Dep. NTIS, $7.50
705	1:11795	Dep. NTIS, $6.75
706	1:11824	Dep. NTIS, $7.75
707	1:11991	Dep. NTIS, $6.00
ISD-166	1:10689	INIS
ITP-75-43R	1:12083	Dep. NTIS (US Sales Only), $3.50
75-73E	1:12084	Dep. NTIS (US Sales Only), $3.50
75-74E	1:12085	Dep. NTIS (US Sales Only), $3.50
75-96E	1:12086	Dep. NTIS (US Sales Only), $5.00
JAB-99-119	1:11291	Dep. NTIS, $6.50
JAPFNR-200	1:10690	Dep. NTIS (US Sales Only), $3.50
201	1:10691	Dep. NTIS (US Sales Only), $3.50
202	1:10692	Dep. NTIS (US Sales Only), $3.50
JEN-307	1:10483	Dep. NTIS (US Sales Only), $6.00
JPRS-66768	1:10466	NTIS
Juel-1236(Pt.1)	1:10845	INIS
K-1839	1:10298	Dep. NTIS, $5.00
1864	1:11284	Dep. NTIS, $14.75
1882	1:11350	Dep. NTIS, $8.50
KFK-2175	1:12305	Dep. NTIS (US Sales Only), $4.00
2229	1:12306	Dep. NTIS (US Sales Only), $4.00
2231	1:11918	Dep. NTIS (US Sales Only), $5.00
KFK-PDV-48	1:12307	Dep. NTIS (US Sales Only), $6.00
54	1:12308	Dep. NTIS (US Sales Only), $3.00
LA-620-4MS	1:12162	Dep. NTIS, $4.50
1018(Vol.8)	1:11122	Dep. NTIS, $9.75
5961	1:11914	Dep. NTIS, $10.75
5987	1:11919	Dep. NTIS, $5.00
5988	1:12141	Dep. NTIS, $4.00
6013	1:10361	Dep. NTIS, $4.50
6019	1:11682	Dep. NTIS, $5.00
6064-MS	1:10992	Dep. NTIS, $4.00
6068-MS	1:11678	Dep. NTIS, $4.50
6069-MS	1:11012	Dep. NTIS, $5.00
6091	1:11141	Dep. NTIS, $6.00
6103	1:11445	Dep. NTIS, $4.00
6108-MS	1:11761	Dep. NTIS, $4.50
6110-PR	1:11523	Dep. NTIS, $4.50
6136	1:12142	Dep. NTIS, $4.50

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6171-PR	1:10455	Dep. NTIS, $5.00
6179-MS	1:10503	Dep. NTIS, $4.00
6180-SR	1:10693	Dep. NTIS, $5.50
6183-PR	1:11506	Dep. NTIS, $4.50
6191-MS	1:11762	Dep. NTIS, $4.50
6197-MS	1:10419	Dep. NTIS, $4.50
6201-MS	1:11920	Dep. NTIS, $6.00
6202-M	1:10340	Dep. NTIS, $5.00
6203-MS	1:12187	Dep. NTIS, $4.50
LA-DC-		
11039	1:11915	Dep. NTIS, $8.75
LA-tr-		
74-3	1:11541	Dep. NTIS, $5.50
75-15	1:11750	Dep. NTIS, $5.50
75-16	1:11749	Dep. NTIS, $4.00
75-35	1:11063	Dep. NTIS, $3.50
LA-UR-		
74-243	1:10694	Dep. NTIS, $4.50
75-2383	1:11301	Dep. NTIS, $3.50
76-318	1:11466	Dep. NTIS, $4.50
76-368	1:11260	Dep. NTIS, $3.50
76-369	1:10420	Dep. NTIS, $3.50
LBL-		
2728	1:11118	Dep. NTIS, $5.50
3291	1:12174	Dep. NTIS, $7.75
3299	1:10932	Dep. NTIS, $5.00
3399(Suppl.)	1:11683	Dep. NTIS, $12.00
3529	1:11717	Dep. NTIS, $9.25
3922	1:11049	Dep. NTIS, $3.50
3979	1:11079	Dep. NTIS, $7.50
4075	1:11331	Dep. NTIS, $3.50
4102	1:11084	Dep. NTIS, $8.00
4114	1:11069	Dep. NTIS, $3.50
4148	1:11013	Dep. NTIS, $7.50
4276	1:11867	Dep. NTIS, $6.00
4277	1:11773	Dep. NTIS, $6.00
4348	1:11332	Dep. NTIS, $3.50
4404	1:10426	NTIS
4416	1:11446	Dep. NTIS, $3.50
4434	1:10242	Dep. NTIS, $5.00
4437	1:10695	Dep. NTIS, $3.50
4444	1:12143	Dep. NTIS, $5.50
4445	1:11463	Dep. NTIS, $3.50
4602	1:11302	Dep. NTIS, $3.50
4632	1:11351	Dep. NTIS, $3.50
4633	1:11507	Dep. NTIS, $3.50
4636	1:12309	Dep. NTIS, $3.50
4702	1:11585	Dep. NTIS, $5.50
LMEC-TDR-		
75-13	1:10526	AT
75-14	1:11221	AT
MATT-		
1157	1:12163	Dep. NTIS, $4.00
1172	1:12107	Dep. NTIS, $4.50
1173	1:12108	Dep. NTIS, $4.00
1175	1:12109	Dep. NTIS, $4.00
1179	1:12225	Dep. NTIS, $4.00
1181	1:12144	Dep. NTIS, $4.00
1183	1:12274	Dep. NTIS, $5.45
1185	1:12110	Dep. NTIS, $4.00
1186	1:12275	Dep. NTIS, $4.00
1195	1:12111	Dep. NTIS, $4.00
1196	1:12175	Dep. NTIS, $4.00
1201	1:12188	Dep. NTIS, $4.00
1208	1:12164	Dep. NTIS, $3.50
1211	1:12176	Dep. NTIS, $4.00
MATT-Trans-		
120	1:12124	Dep. NTIS, $3.50
MDC-G-		
4442	1:11035	Dep. NTIS, $4.00
MERC/TPR-		
76/1	1:10276	Dep. NTIS, $3.50
MESA-IR-		
1006	1:10254	Dept. of the Interior, Arlington, VA
MHSMP-		
71-113	1:11405	Dep. NTIS, $3.50
73-18D	1:11406	Dep. NTIS, $3.50
76-2	1:11407	Dep. NTIS, $3.50
MIT-		
2793-1	1:11184	Dep. NTIS, $3.50
MIT-EL-		
75-017	1:10823	*See* PB-244741
75-020	1:10909	*See* PB-247141
75-021	1:10851	NTIS
76-001	1:10763	*See* PB-250592
76-002	1:10763	*See* PB-250592
ML-		
2387	1:11253	*See* AD/A-007838
MLM-		
2003(tr)	1:11149	Dep. NTIS, $3.50
2203	1:10371	Dep. NTIS, $4.00
MRC-DA-		
435	1:10266	*See* PB-240637
N-		
74-31527	1:10431	NTIS, $3.25
75-28518	1:10884	NTIS, $7.00
943-75-03	1:10691	*See* JAPFNR-201
943-75-04	1:10690	*See* JAPFNR-200
943-75-05	1:10692	*See* JAPFNR-202
NAMRL-		
1195	1:11546	*See* AD/A-005898
NASA-TM-X-		
71585	1:10431	*See* N-74-31527
NBS-TN-		
892	1:10885	GPO, $1.70, SD Cat. No. C13.46:892
NBSIR-		
74-389	1:10253	*See* COM-74-11717
NEDO-		
20566(Vol.1)	1:10696	General Electric Co., San Jose, CA
20566(Vol.2)	1:10697	General Electric Co., San Jose, CA
NERC-LV-		
539-29	1:11470	Dep. NTIS, $5.45
NOLTR-		
74-157	1:11424	*See* AD/A-004942
NP-		
20656	1:10891	TIC
20663	1:10892	TIC
20664	1:10877	TIC
20665	1:10862	TIC
20666	1:10818	TIC
20667	1:10819	TIC
20668	1:10820	TIC
20669	1:10783	TIC
20670	1:10784	TIC
20671	1:10852	TIC
20672	1:10893	TIC
20673	1:10894	TIC
20674	1:10895	TIC
20675	1:10863	TIC
20676	1:10853	TIC
20677	1:10821	TIC
20678	1:10770	TIC
20680	1:10771	TIC
20728	1:10269	Federal Energy Adm., Washington, DC
20758	1:10854	
20788	1:10256	Bureau of Mines, Washington, DC
20793	1:10467	NRC, Washington, DC
20796-P2	1:10848	GPO, $4.30
20796-P3	1:10849	GPO, $12.75
20804	1:10252	Tennessee Energy Office, 250 Capitol Hill Bldg., Nashville, TN 37219
20813	1:10463	Duke Power Co., Charlotte, NC
20825	1:10468	Battelle Columbus Labs., OH
20838	1:10599	Western Interstate Nuclear Board, Lakewood, CO
20844	1:10762	Dep. NTIS (US Sales Only), $9.25
NRL-		
7838	1:12251	*See* AD/A-006250
NRL-MR-		
2748	1:11437	*See* AD/A-007872
2998	1:11042	*See* AD/A-008337
NSF-		
75-500	1:10896	GPO, $17.75 (2 vols.), Stock No. 038-000-00230-9
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75-050	1:10826	*See* PB-248997
NSF/RA/N-		
74-118	1:10490	*See* BNWL-CC-1401
74-210	1:10798	*See* PB-243627
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75-03972/FR/75/1	1:10405	*See* COO-2593-1

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NSWC/DL-TR-3151	1:10257	*See* AD-A-009852
NTIS/PS-75/363	1:10897	NTIS, $25.00
75/661	1:11050	NTIS, $25.00
75/748	1:11471	NTIS, $25.00
75/854	1:10910	NTIS, $25.00
NUREG-75/099	1:10609	NTIS, $5.50
0008	1:10312	*See* DOCKET-701729-7
0009	1:10313	*See* DOCKET-701729-8
0010	1:10303	NTIS, $5.50
NUREG/PRDI-76/1	1:10586	TIC, $3.50
ORNL-5035	1:10629	Dep. NTIS, $7.75
5078	1:10527	Dep. NTIS, $8.50
5101	1:10529	Dep. NTIS, $7.00
5102	1:10698	Dep. NTIS, $6.00
ORNL-NSIC-120	1:10699	Dep. NTIS, $15.00
123	1:10700	Dep. NTIS, $12.00
ORNL/TM-3790(Pt.3)	1:12310	Dep. NTIS, $4.50
4870	1:10316	Dep. NTIS, $5.50
4927	1:11036	Dep. NTIS, $5.00
5000	1:12057	Dep. NTIS, $5.45
5014(Vol.3)	1:10650	Dep. NTIS, $7.00
5035	1:12204	Dep. NTIS, $5.00
5074	1:10993	Dep. NTIS, $4.00
5098	1:11966	Dep. NTIS, $5.50
5105	1:11371	Dep. NTIS, $5.50
5108	1:10630	Dep. NTIS, $4.00
5114	1:12220	Dep. NTIS, $5.00
5115	1:11176	Dep. NTIS, $7.00
5133	1:10305	Dep. NTIS, $5.50
5138	1:11554	Dep. NTIS, $5.00
5155	1:10701	Dep. NTIS, $4.00
5161	1:11961	Dep. NTIS, $5.00
5184	1:12221	Dep. NTIS, $5.00
5191	1:11169	Dep. NTIS, $4.50
5203	1:11953	Dep. NTIS, $5.00
5204	1:11940	Dep. NTIS, $5.00
5206	1:10504	Dep. NTIS, $5.00
5209	1:10341	Dep. NTIS, $5.50
5210	1:10456	Dep. NTIS, $6.00
5224	1:11921	Dep. NTIS, $6.50
5237	1:12145	Dep. NTIS, $5.00
5241	1:11954	Dep. NTIS, $5.50
5257	1:11623	Dep. NTIS, $5.00
5263	1:10702	Dep. NTIS, $5.00
5268	1:10703	Dep. NTIS, $4.50
5279	1:10704	Dep. NTIS, $3.50
5280	1:12189	Dep. NTIS, $5.00
5309	1:11294	Dep. NTIS, $3.50
ORNL-tr-2999	1:10317	Dep. NTIS, $5.00
4031	1:11461	Dep. NTIS, $4.50
4032	1:11462	Dep. NTIS, $4.50
4080	1:12118	Dep. NTIS, $3.50
4082	1:11162	Dep. NTIS, $3.50
4088	1:12117	Dep. NTIS, $3.50
4089	1:10984	Dep. NTIS, $3.50
4098	1:11763	Dep. NTIS, $3.50
ORO-1797-62	1:11147	Dep. NTIS, $3.50
3105-52	1:10954	Dep. NTIS, $3.50
3992-243	1:11825	Dep. NTIS, $3.50
3992-244	1:11826	Dep. NTIS, $4.00
3992-246	1:11884	Dep. NTIS, $4.00
3992-249	1:11838	Dep. NTIS, $3.50
4044-6	1:10982	Dep. NTIS, $4.00
4338-8	1:12112	Dep. NTIS, $4.00
4627-2	1:12113	Dep. NTIS, $3.50
4761-4	1:11539	Dep. NTIS, $5.00
4856-44	1:11905	Dep. NTIS, $3.50
4856-48	1:11303	Dep. NTIS, $3.50
4939-3	1:11481	Dep. NTIS, $4.00
4946-1	1:10251	Dep. NTIS, $5.00
5010-1	1:10940	Dep. NTIS, $3.50
P-5498	1:10881	Rand Corp., 1700 Main St., Santa Monica, CA 90406, $1.50
PA-TR-4692	1:11376	*See* AD/A-005590
PATENTS-DE-2445953/A/	1:10382	
PATENTS-US-A512,810	1:11264	
A555,330	1:10712	
A555,754	1:11409	
A556,353	1:11148	
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A560,427	1:10916	
A560,430	1:11214	
A561,561	1:10971	
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A567,340	1:10332	
A568,809	1:11509	
A570,924	1:10353	
A570,925	1:10333	
A571,445	1:10970	
A571,655	1:10234	
A577,822	1:11408	
A579,179	1:10418	
A580,499	1:10288	
A582,056	1:11493	
3,900,367	1:10641	
3,909,350	1:10632	
3,909,351	1:10506	
3,910,673	1:11295	
3,910,714	1:10536	
3,910,816	1:10633	
3,910,817	1:10472	
3,910,818	1:10471	
3,911,272	1:11398	
3,911,280	1:11339	
3,911,684	1:10324	
3,912,582	1:10647	
3,912,583	1:10533	
3,912,584	1:10537	
3,912,625	1:11190	
3,912,908	1:10642	
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3,913,481	1:11415	
3,913,599	1:11288	
3,913,657	1:11090	
3,913,689	1:10634	
3,914,054	1:11399	
3,914,133	1:10755	
3,914,371	1:11089	
3,914,373	1:11171	
3,914,388	1:10318	
3,914,392	1:11096	
3,914,612	1:10358	
3,914,613	1:10643	
3,914,681	1:11311	
3,914,732	1:11416	
3,915,018	1:10635	
3,915,119	1:11091	
3,915,499	1:11151	
3,915,695	1:10972	
3,915,742	1:10759	
3,915,792	1:10539	
3,916,200	1:11354	
3,916,338	1:11270	
3,916,432	1:11235	
3,916,686	1:11292	
3,917,369	1:11400	
3,917,509	1:10567	
3,917,782	1:11064	
3,918,812	1:11401	
3,918,818	1:11522	
3,918,839	1:10432	
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3,919,273	1:11209	
3,919,274	1:11210	
3,919,406	1:10383	
3,919,580	1:11312	
3,920,343	1:11231	
3,920,395	1:11172	
3,920,577	1:10338	
3,920,788	1:11211	
3,920,989	1:11375	
3,920,995	1:11215	
3,921,405	1:11423	
3,922,231	1:11152	
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3,922,872	1:10389	
3,922,903	1:11293	
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